Accessing Healthy Food: A Sentinel Mapping Study of Healthy Food Retailing in Scotland

Research Project S04005
Food Standards Agency (Scotland)

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Final Report to the Food Standards Agency (Scotland)
Project No. S04005

October 2007

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Final Report to the Food Standards Agency (Scotland), February 2007
Project No. S04005
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EXECUTIVE SUMMARY

Introduction

The issues underpinning food access and availability have provided one of several foci of debate in Scotland in respect of the relationships between diet and health. The key question has been 'Within Scotland, are there significant differences in the accessibility to affordable sources of healthy food?' A supplementary question then arises; 'If differences are present, are they linked to the social dimensions of affluence-deprivation and urbanism-rurality?'

The Food Standards Agency Scotland commissioned research to explore these questions and answers to them. The research was undertaken between 2005 and 2007 by the Centre for the Study of Retailing in Scotland. The project was based in The University of Edinburgh and drew on a range of expertise from specialists in retailing, nutrition, geography, marketing, statistics and geographical information systems based in Edinburgh and other Universities.

Objectives

The objective of the research project was to provide an objective and systematic evaluation of access in terms of the availability and affordability of a selected range of healthy food items, thus providing information to improve understanding of any structural constraints or limitations that might make it difficult to achieve the national policy objective of improved diet.

In order to achieve this it was essential to create two foundations:

- a database of stores selling food and
- a list of indicative healthy foods.

From these foundations it was then possible to identify key sites (sentinel survey sites) within which to investigate food access in a detailed systematic way using a survey instrument that could be of more general applicability after the conclusion of the research project.

Methods

A review of previous research identified several studies (within and outside the UK) that suggested the importance of socio-economic variables to the issue of improving diet, but few addressed specifically the issues of accessibility and affordability. A number of these studies considered the concept of 'food deserts' as areas in which there was an absence of shops selling food and the consequential problem of access to places to purchase food. Although the concept was articulated in these studies, few were able to prove the existence of such areas. The review of previous studies provided useful pointers for the current research but did not provide studies either for direct comparison with the situation in Scotland or of direct value in terms of research design.

The research design adopted for the project comprised a dual approach of mapping the location of food stores across Scotland to provide a macro-perspective on access and, in tandem, empirical survey of the availability and price of selected foods in small areas to provide a micro-perspective.

The macro-study compiled a database on 5923 food stores and developed a geographical information system to map and analyse these data. As no single comprehensive data source exists on the number, type and location of food stores in Scotland, the database was compiled from a variety of sources. Medium and large stores, (i.e of over 3,000 sq ft,) were able to be identified separately by floorspace within the database. Change in the population of shops was monitored over the period of the project.

The micro-study involved identification of 9 survey areas, termed survey sentinels, in which detailed surveys were undertaken at all shops within the area. The survey sentinels were selected to represent different socio-economic environments, in respect of affluence-deprivation and urbanism-rurality. Paired deprived and affluent sentinels were selected in urban, rural and small town environments with the addition of two Island sentinels to enable exploration of this specific environment. In each sentinel, all food shops were visited and the presence and prices of a range of healthy food products were recorded. These data were collected for a total of 466 shops across the sentinels.

The foods for which data were recorded were selected as indicators of the presence of a range of healthy foods. This list of foods, especially devised by the project team, is termed the Healthy Eating Indicator Shopping Basket (HEISB). It comprised a total of 35 items drawn from 5 major food groups.

The survey methodology for the micro-study was developed as an independent survey tool that could be used by other researchers to undertake surveys of the presence of a range of healthy foods and to monitor changes in the availability and affordability of the foods.

Results

The results of the macro-study have proven the feasibility of establishing a database and associated GIS of food shops in Scotland – in effect a basic Food Map of Scotland. This map indicates that there is an extensive network of food shops across all the socio-economic environments in Scotland. Levels of accessibility vary considerably with an estimated 250,000 people living more than 10 km from a medium or large food shop and approximately 3 million living within 1 km of a medium or large food shop. The pattern of provision is dynamic. There is a need to monitor these changes and update the database and GIS with store closures and openings.

The results of the micro-study indicated that the HEISB tool, as an indicator of availability of healthy foods, discriminated well amongst stores in terms of the food stocked. In the large stores and some of the medium sized general stores a full range of the 35 HEISB items was available. Small stores generally stocked around half of the HEISB. Small stores stocking a wider range were present in more remote rural areas. Across the stores surveyed, the fruit and carbohydrate groups were normally more available than the vegetable group with the protein-rich group less available in small stores and in more deprived areas. Overall the total number of HEISB foods available per shop was weakly negatively correlated with deprivation; as deprivation increases the number of foods available falls. There are a number of stores in the deprived areas having a good range of the HEISB items. Store operation is more important than location in a deprived or affluent area in influencing availability of HEISB items.

There was a considerable range of price for the HEISB items across the stores and the sentinel areas surveyed. The total HEISB median price varied substantially by store type from £37.48 in large stores, £40.30 in medium sized stores, to £47.83 in small stores. Although in the survey of availability it was seen that many small general food stores, in many cases in rural areas, had a relatively high percentage availability of indicator foods, it is apparent that this comes at a relatively high price. Across the 9 sentinel areas the total HEISB median price ranged from £52.75 to £42.30. The 3 sentinels with the highest price for the HEISB all have a significant deprived element: rural deprived £52.75, the Island sentinel £49.18 that contains notably deprived areas, and, small town deprived £47.25. There is a tendency for prices to be lower in areas with a low level of social and economic deprivation. The study has not proved a conclusive link between deprivation and price of HEISB, but when the pairs of Rural, Island and Small Town sentinels are considered the more deprived sentinel in each case has a higher price for the HEISB.

Conclusions

The project has shown the values of combining macro and micro level study to address the question 'Within Scotland, are there significant differences in the accessibility to affordable sources of healthy food?' In general, using the specific methodology designed for this research there is no evidence to support a view of the presence of urban 'food deserts'. Accessibility to a range of healthy food as indicated by the presence of key items depends more on the presence of medium and large stores than being in a deprived or affluent area. The contrast in HEISB availability between small general stores and the medium and large stores is very clear.

The price of items in the HEISB varied considerably across stores and across the survey areas. There is a tendency for prices to be lower in larger shops and in areas with a low level of social and economic deprivation.

The total survey instrument proved useful in establishing what foods were available and at what cost in different socio-economic environments in terms of the overall basket and of individual items. As a research instrument it was shown to have a sufficient degree of sensitivity to indicate where there are specific issues in terms of availability and price of specific products.

The research has shown the need for a regular, systematic and co-ordinated update of a database on food retail provision within Scotland. This would allow trends in food availability and access to be followed, and effective policy to be delivered and monitored.

The research has generated recommendations concerning future research to extend the analysis in the report to other areas, to monitor the changes in the accessibility and price of healthy food and to consider ways to encourage small general food shops to increase the range of healthy foods.

ACKNOWLEDGEMENTS

The authors would like to thank and acknowledge the contribution of the following to the project:

- Tina Parkin and Lynn Walford of CSRS University of Edinburgh for their valuable administrative support;
- Prof. Annie Anderson (consultant) and Jennifer Dewar at the University of Dundee for their expertise and insights in nutrition;
- Dr Wilson Mcleod at Celtic and Scottish Studies, University of Edinburgh, for his Gaelic translation skills;
- Anna Whyte, Anne Milne, Gillian Dalgleish and Cheryl White at Food Standards Agency (Scotland) for their project guidance;
- Laura Nisbet (PhD student, University of Edinburgh), Zoe Aitken (Research Assistant, Queen Mary, University of London) and Bill Gray at Community Food and Health (Scotland) formerly Scottish Community Diet Project for their individual contributions.
- Prof Martin White, University of Newcastle, for his useful personal insights into the research and analysis for Food Standards Agency Project No. N09010.

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GLOSSARY OF TERMS

BOGH = Balance of Good Health.

The Balance of Good Health is a pictorial food guide showing the proportion and types of foods that are needed to make up a healthy balanced diet. The Balance of Good Health has been produced by the Food Standards Agency as a guide that aims to help people understand and enjoy healthy eating.

Ref: http://www.nutrition.org.uk/home.asp?siteId=43andsectionId=874andparentSection=320andwhich=1

CSRS = Centre for the Study of Retailing in Scotland.

CSRS is a SHEFC funded inter-university collaboration involving the universities of Stirling, Edinburgh and Strathclyde. The CSRS aims to enhance the knowledge and understanding of the retail sector in Scotland.

Ref: http://www.csrs.ac.uk/home.htm

DZ = Data zone.

Data zones are a small area geography developed by the Scottish Executive for use in Scottish Neighbourhood Statistics to allow statistics across a number of policy areas to be readily (and regularly) available on a consistent and stable geography. There are 6505 data zones in total covering the whole of Scotland and nesting within local authority boundaries. Data zones are groups of Census output areas which have populations of between 500 and 1,000 household residents.

Ref: http://www.scotland.gov.uk/Publications/2004/02/18917/33244

GROS = General Register Office for Scotland.

GROS are part of the devolved Scottish Administration. They are responsible for the registration of births, marriages, civil partnerships, deaths, divorces, and adoptions. They also run the Census in Scotland and use the Census and other data to publish information about population and households.

Ref: http://www.gro-scotland.gov.uk/

GIS = Geographic Information System.

A computer system for capturing, storing, checking, integrating, manipulating, analysing and displaying data related to positions on the Earth's surface. Typically, a Geographical Information System (or Spatial Information System) is used for handling maps of one kind or another. These might be represented as several different layers where each layer holds data about a particular kind of feature. Each feature is linked to a position on the graphical image of a map.

Ref: http://www.geo.ed.ac.uk/agidexe/term?271

GPS = Global positioning system.

A satellite based navigational system allowing the determination of any point on the earth's surface with a high degree of accuracy given a suitable GPS receiver. This accuracy varies between 5 and 50 m or more depending on local topography, e.g. tall buildings can distort signals, and the quality of equipment used.

Ref: http://www.geo.ed.ac.uk/agidexe/term?275

HEISB = Healthy Eating Indicator Shopping Basket.

A set of 35 food items designed by this project. The extent of the presence of these items on a food shop's shelves is indicative of the availability of healthy eating options to customers. See section B.4 for further information.

IGD = Institute of Grocery Distribution.

The Institute of Grocery Distribution (IGD) is a UK registered charity with the purpose of providing thought leadership and supply chain best practice for the food and grocery industry.

Ref: http://www.igd.com/

NDNS = National Diet Nutrition Survey.

The National Diet Nutrition Survey is one of a programme of surveys with the aim of gathering information about the dietary habits and nutritional status of the British population. It is based on a national sample of adults aged 19 to 64 years. The results of the survey will be used to develop nutrition policy and to contribute to the evidence base for Government advice on healthy eating.

Ref: http://www.food.gov.uk/science/101717/ndnsdocuments/

NS = a shop participating in the Scottish Executive's Neighbourhood Shops initiative.

Ref: http://www.scotland.gov.uk/Topics/Health/health/19133/wisefood

PAF = Postcode Address File.

The Postcode Address File is an almost complete list of all postal addresses and postcodes in the United Kingdom. It is managed by the Royal Mail under the terms of its licence.

Ref: http://www.psc.gov.uk/royal-mail-standards-and-prices/postcode-address-file.html

PFS = Petrol Filling Station.

PYOP = Pick-your-own-produce.

SCDP = Scottish Community Diet Project.

The Scottish Community Diet Project's aim is to help improve Scotland's diet and health by supporting work within low-income communities which improves access to and take-up of a healthy diet. SCDP supports both community initiatives and inter-agency partnership working. From 17 November 2006 SCDP has been known as Community Food and Health (Scotland).

Ref: http://www.communityfoodandhealth.org.uk/

SDAP = Scottish Diet Action Plan.

The plan, ***'Eating for Health: A Diet Action Plan for Scotland'***, was published by the then Scottish Office in 1996, following a two-year inquiry, involving stakeholders from agriculture, the retail industry, public health and consumer interest groups.

Ref: http://www.scotland.gov.uk/Topics/Health/health/19133/17710

SDAP Review.

In the autumn of 2005 a review of the effectiveness and appropriateness of the implementation of the Scottish Diet Action Plan, following nine years of implementation, was conducted.

Ref: http://www.healthscotland.com/understanding/evaluation/policy-reviews/review-diet-action.aspx

Sentinel.

A geographically delimited case-study area for the purpose of focused analysis of food retailing within this project. These areas were selected to be typical of different socio-economic environments in Scotland. The sentinels are defined by a set of data zones. The data zones in a single sentinel may be geographically contiguous or may be separated into a number of sites within a sentinel, e.g. in the case of a number of small towns sharing the same characteristics or a number of islands within an archipelago.

SEUR = Scottish Executive Urban Rural classification.

The Scottish Executive Urban Rural Classification (previously called the Scottish Household Survey Urban Rural Classification) was first released in 2000. It provides a six-fold or eight-fold classification of ruralness and urbanness. The Scottish Executive's Partnership Agreement sets out that the Scottish Executive will ensure that rural and remote communities have their distinct needs reflected across the range of government policy and initiatives. This classification supports the commitment and helps develop understanding of the issues facing urban, rural and remote Scotland.

Ref: http://www.scotland.gov.uk/Publications/2004/06/19498/38784

SGF = Scottish Grocers' Federation.

The Scottish Grocers' Federation (SGF) is the trade association for the Scottish Convenience Store Sector. It brings together a range of retailers throughout Scotland, including all of the Scottish Co-ops, Aberness/Somerfield, C J Lang and Son Ltd (the main Spar wholesaler and store operator), Botterills and other smaller and local independents (which are the largest category of members).

Ref: http://www.scottish.parliament.uk/business/committees/environment/inquiries/pb/Scottish_Grocers_Federation_submission.pdf

SIMD = Scottish Index of Multiple Deprivation.

The Scottish Index of Multiple Deprivation identifies small area concentrations of multiple deprivation across all of Scotland in a consistent way. It allows effective targeting of policies and funding where the aim is to wholly or partly tackle or take account of area concentrations of multiple deprivation. The first Index (SIMD 2004) was published in June 2004. The SIMD was updated for 2006 on 17 October 2006.

Ref: http://www.scotland.gov.uk/Topics/Statistics/SIMD/Overview

Symbol groups

A symbol group retailer is an independent retailer that is a member of a larger organisation known as a "symbol group operator" (such as SPAR). The retailer displays a branded fascia in order to have a common trading identity which shoppers recognise. In addition they gain a number of other benefits associated with belonging to a larger organisation, such as improved buying terms, branding, the option to sell own label products, and new shop technology. IGD (2006).

1. INTRODUCTION

1.1. Background

1.1.1. Food access, diet and health

The poor quality of the Scottish diet has been well documented for a number of years as a fundamental factor contributing to Scotland's poor health record. Publications pertaining to this include Scottish Diet Action Plan (Scottish Office, 1996) and Review (Scottish Executive, 2006a), Improving Health in Scotland(Scottish Executive, 2003), FSAS Diet and Nutrition Strategy (FSAS, 2003). Figures on mortality rates in Scotland, indicate that the incidence of heart disease and stroke are falling. Nonetheless it is acknowledged by government that:

> *"Major challenges remain, particularly in tackling health inequalities. Despite big improvements, those in the most deprived areas are still far more likely to die than those in the least deprived. That's why preventative care aimed at communities with the greatest health needs is so necessary. ... Stopping smoking, improving diet and increasing levels of physical activity are at the heart of health improvement."*
> Scottish Executive (2006b)

Lifestyle changes, including improving poor dietary intake, lie at the heart of responding to these challenges. But lifestyle changes require both knowledge about the changes to be made and the capability to make the changes.

Access to a range of healthy food can be constrained by a variety of physical, economic, cultural and social factors. Establishing policies to improve food availability, affordability and choice is a stated aim of many governmental and non-governmental organisations working outwith and within Scotland, as stated in *Eating for Health: a Diet Action Plan for Scotland* (Scottish Office 1996).

In 2003, the Food Standards Agency Scotland (FSAS) published its *Diet and Nutrition Strategy* to highlight its role in implementing the Scottish Diet Action Plan. A number of recommendations were made of ways to improve diet in Scotland, including the key objective to:

> *"Increase access to healthier food choices, particularly in low income and rural areas"* (FSAS 2003, p.11)

Socio-economic status and levels of deprivation have consistently been found to be an indicator of dietary intake. The Scottish Health Survey (2003) found that fruit and vegetable consumption varied by socio-economic group, with consumption decreasing as household income decreased and deprivation increased. Eating habits were also shown to vary between socio-economic groups. People in the lowest income households, and the most deprived areas were more likely to have less healthy eating habits (higher consumption of non-diet soft drinks, crisps, savoury snacks, chips and meat products) than those in the highest income households in the least deprived areas (Scottish Executive, 2005).

1.1.2. Review of previous work

The term "food access" takes into consideration the complexity of factors that affect a person's ability to obtain sufficient food for good health - including having enough money to buy food, being physically able to walk or drive to shops which can provide food and understanding how to prepare

and use healthy foods (NCH, 2004). Although much discussion and work continues to be carried out in this area (e.g. Scottish Executive, 2000, 2003, O'Neill, 2005, NHS Scotland, 2005), as yet there is no widely agreed definition of what constitutes "adequate" access to food.

Areas of perceived poor access to food have become termed "food deserts", defined by the Low Income Project Team (1996) as "areas of relative exclusion where people experience physical and economic barriers to accessing healthy food". This term has been widely used in both research (Whitehead 1998, Furey, 2001) and policy papers (Department of Health, 1996, Acheson 1998). The evidence to support the claimed presence of such areas is disputed (Cummins and Macintyre, 2002, Wrigley, 2002) as results are often contradictory, anecdotal or misinterpreted. Some of this confusion can be explained by the difficulties faced when making comparisons between studies in the same field which use varying survey designs.

Research in the field to date does not conclusively show the existence of 'food deserts', but there appears to be a food access problem in terms of limited choice of products available and at a higher price in certain areas, and that these areas may be the more socio-economically deprived. Ownership of a car can exacerbate this problem in that people may be more restricted to shopping at the stores closest to them. The most adversely affected however, and those at most risk, are consumers with limited mobility i.e. the elderly, infirm or disabled who are most heavily dependent on their local stores for food provision (Acheson, 1998; Caraher *et al*, 1998; Furey *et al*, 2002).

Ruston (2002) found that 6% of the population as a whole found it difficult to access a supermarket, however this increased to 16% when the household did not have access to a car. People with cars travel further for shopping (Social Exclusion Unit, 2003) which increases their choice of store and subsequently the range of food items available to them. Within rural areas in the UK as a whole the problem of local access is magnified as 78% of rural settlements do not have a general food store or a small village shop and this further restricts their access to any food provision (Social Exclusion Unit, 2003). In rural areas consumers adopt coping behaviour and motor vehicle use is higher than in urban areas. Nonetheless, for rural consumers, drive times to supermarkets are on average higher than for urban residents

White *et al* (2004) concluded that "food deserts" only exist for a minority of people who do not or cannot shop outside their immediate locality and for whom the locality suffers from poor retail provision of foods that make up a 'healthy' diet. There is therefore an interplay between physical location and the the decisions of retailers on what items to include in their ranges.

The issue of food access is not limited to the United Kingdom. It is a pertinent issue in other countries, for example USA (Block, 2006, Block and Kouba, 2006; Zenk *et al*, 2005; Moore *et al*, 2005; Glanz et al, 2004), Canada (Smoyer-Tomic *et al, 2006*, Michaud *et al*, 2004) and Australia (Inglis *et al*, 2005, Lee *et al*, 2002). Although studies in the US and Canada both investigate the same problem as in the UK, they tend to focus more on economic access and the notion of 'food security', a term used to define 'a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life' (FAO, 2001).

1.1.3. Methodological issues

In Scotland, empirical evidence on 'mapping' geographical variations in food retailing, price and availability have focused on case studies of particular local urban and rural environments. Early work in Glasgow and Edinburgh (Sooman *et al* 1993, Forsyth *et al* 1994, Edinburgh Community Food Initiative 1999) found that healthy food was more expensive and less available in poorer

compared to richer areas within each city. Clark *et al* (1995) in their study of the Western Isles highlighted that, among other things, major barriers to pursuing a balanced diet were the very limited availability of food items, particularly fresh fruit and vegetables and high prices consequent on transportation costs. In the UK, more recent work provided compelling evidence that there were continuing food access problems in well-defined local areas (Dowler *et al* 2001, White *et al* 2004). However, there was limited evidence of systematic differences in food retailing, price and availability (Cummins and MacIntyre 2002). Research projects in Glasgow and Leeds evaluated the health impacts of change in food retail provision within deprived communities and demonstrated that there may be small benefits to dietary and general health, but with potentially greater importance for the policy debate (Petticrew *et al* 2005, Wrigley *et al* 2003).

The location of the research site itself is often influenced by the location of the researchers, whether previous research has been done there before and/or whether there are any existing data sets on the area to provide a foundation from which to begin. Guy and David (2004) chose Cardiff as one of their case studies into the wider investigation into 'food deserts' because it contained areas of serious social deprivation and because it had been the subject of previous research into food shopping development, access and pricing. They concluded that, in their sample, access to stores across a range of socio-economic geographical areas was adequate but that local general stores were unable to compete with larger, out-of town supermarkets on availability or price.

Most studies in this field have used as part of their research a 'shopping basket' or a set of items as a means of assessing food availability. Methodologically, however, food basket surveys are open to criticism. There are a number of issues involved in defining "what is in a healthy basket" and, as such, the decision on basket content is contentious. Most studies have used nutritional content to some degree as an indicator of health however none offer a robust definition of a standardised 'healthy' basket. Previous research has used baskets based on one or more of the following: local/ethnic tastes, nutrient based, 'modest-but-adequate' and indicator foods (e.g. ten common items) (Donkin *et al*, 1999; White *et al*, 2004; Guy and David, 2004).

Research on access to basket items is very specific to the objectives and locale of the research. Donkin *et al* (1999), in looking at food ethnicity, considered walking access in two contiguous London Wards (Electoral Divisions) using 500 m as reasonable physical access. They estimate distance using the point location of the postcode of the shop and the road network. Whilst this approach is practicable for urban areas it is less useful, and less precise, in rural areas, as walking access is often unrealistic and the geographic area represented by a postcode becomes much larger. It is therefore important to tailor this aspect of the research methodology to the particular location chosen.

Studies in the UK have tended to focus on the physical aspects, such as poor levels of access to reasonably priced, nutritious, good quality food. Irrespective of this difference, there are some similarities in terms of research methodology (*i.e.* shopping basket surveys). Caution needs to be applied when comparing findings from different studies both within a country and across countries due to the differences in the detail. In some instances international findings have mirrored those from UK work in this field with several recurring key issues which seem to be at the crux of the food access debate. These include socio-economic status, location of store, range of stock, item price, item quality and transport access.

For example, Block *et al*'s (2006) basket survey in Chicago found many grocery stores in the sample area to be competitively priced but that overall quality was low compared to that in larger supermarkets. Further he concluded that the problem of food access was more linked to store type than number of stores in a particular area. Other studies in the USA by Moore *et al* (2005) and Zenk *et al* (2005) added the dimension of ethnicity to the issue and found that access to food stores was

poor in deprived areas and poorer still in deprived areas with a predominantly ethnic minority population, an issue that so far been under-researched in the UK.

1.1.4. Need for present work

In spite of concerted efforts to improve the situation, an analysis (Wrieden *et al*, 2005) of dietary data has shown that there has been little shift in nutrient intake across Scotland over the last decade. There is now an increasing focus and commitment to tackle this problem (Scottish Executive, 2004, Scottish Executive, 2006).

Explanations exist for the poor Scottish diet, e.g. Ellaway and MacIntyre (2004), however no clear nationwide evidence has been collected.

Previous UK studies on access to healthy food, or the absences thereof, have primarily targeted well-defined urban areas for the research location, e.g. Cardiff, Leeds, Newcastle, London and Glasgow have all been the focus of food access research. Although White *et al*'s (2004) work in Newcastle is one of the largest and most in-depth pieces of research in this field it is largely confined to a predominantly urban area and is unlikely to be applicable to rural areas. Similarly, the findings for Newcastle may differ from those of other major UK cities.

The geographic distribution of large full-range supermarkets and discount supermarkets and their associated transport access mechanisms are of paramount importance in providing healthy food (Scottish Office, 1996; White *et al*, 2004). The ability to form a nationwide interactive picture of this distribution, in relation to the important social determinants, has vastly improved over recent years due to the advances in Geographic Information Systems (GIS) and in the supply of data to populate the GIS.

An interactive GIS offers the ability to take into consideration other important characteristics of the distribution of retail provision. Freshness, range and out-of- stock issues are important factors and larger stores are more attractive because of perceptions that increased turnover leads to increased freshness of produce (Marshall *et al* 1995; Skerrat 1999).

A number of studies highlight the changing dynamics of the retail market over the last 10 years (Cummins and MacIntyre, 1999; Furey *et al*, 2002; Guy and David, 2004), notably, the increase of out-of town retail outlets and the number of larger supermarkets opening in these locations. This has been linked also to the relative demise of smaller stores possibly as a direct consequence of these larger stores opening with a wider choice, better quality and lower prices. It is argued that the presence of one of the large stores operated by a large firm can be beneficial to consumers as it can lead to greater price competition and tends to lower prices in general stores. Nonetheless, numerous studies indicate that on comparison, the price of the basket of items in 'symbol' stores remains higher than in larger supermarkets even in competitive situations (Guy and David, 2004; National Consumer Council, 2005; Furey *et al*, 2002). The conclusion of such studies is that the retail store offers more than simply items at a price but provides a bundle of retail services of which price is but one. In support of this, research has shown that price, per se, has been found to be less important and is mostly an issue for the non-economically active. Price reductions do not necessarily precipitate increases in consumption. Clarke *et al* (2002) argue that rather than one large store opening it may be more beneficial all round to open several smaller stores within an area. This can encourage price competition and reduce the likelihood of established smaller stores closing thus ensuring that those most affected by access issues e.g. the elderly or infirm or those without cars will not lose out and still see the benefits of a wider choice at a more reasonable price. The counter argument to this study is that the smaller stores offer a more limited bundle of services to the

consumer, so that overall welfare is reduced. These arguments tend to focus on the situation in urban areas.

1.2. Aims and objectives

In 2005 the Food Standards Agency Scotland (FSAS) commissioned the Centre for the Study of Retailing in Scotland (CSRS), at the University of Edinburgh, to undertake a study of the availability of, and accessibility to, healthy food in Scotland. The research was to be based on detailed studies of selected local areas typical of different socio-economic environments in Scotland. The study would provide insights into the relationship between accessibility and availability on the one hand, and degrees of affluence-deprivation and urbanism-rurality, on the other. The use of a research design using small area studies, termed sentinels, was to provide a basis for more general statements on availability and accessibility to healthy foods across Scotland.

The project aimed to fill the 'knowledge gap' by producing a national picture of food retailing in terms of availability and affordability identified through research in nationally representative local case study sentinel sites. The project would establish a national view of food retailing in Scotland and understand how access to healthy food varied for different groups. The two main issues being addressed were the:

- establishment of an appropriate indicator basket of 'healthy' foods;
- determination of access to that basket in terms of retail provision and associated factors such as location, price and transport.

Previous work has guided the project but the approach and instruments have been specifically designed to make them relevant to the Scottish situation, e.g. wide variation of scales from urban to rural; a non-homogenous sampling frame.

This research was instigated to address the need to undertake a systematic and rigorous national assessment of food retailing, availability and affordability in order to help clarify conflicting evidence, and to provide a robust evidence base that will inform policy decision-making and identify areas that have particular access problems for targeted intervention.

Taking into account the relative merits of previous approaches, this research generates and utilises its own list of certain key, nutritionally balanced, healthy items which formed the core of a "healthy basket" that is indicative of the availability of choices for consumers in respect of healthy food items.

The project has been designed so that, if the need exists, it can be used as the basis for an ongoing surveillance system of food access in Scotland.

2. METHODOLOGY

2.1. Research design

The methodology comprised the following stages in order to achieve the objectives of the study:

1. Mapping food retail access in Scotland (section 2.2);
2. Establishment of areas of study (sentinels) in which detailed surveys of the availability and price of healthy food would be undertaken to understand healthy food access issues for consumers living in a variety of different environments and circumstances (section 2.3);
3. Establishment of an indicator list of healthy food, Healthy Eating Indicator Shopping Basket (HEISB), that would form the basis of the survey (section 2.4);
4. Field survey of availability and price of foods on the HEISB indicator list (section 2.5);
5. Quality assurance and coding of data collected (section 2.6).

Data collected on this methodology were then subjected to statistical and cartographic analyses (section 2.7), and conclusions and recommendations drawn from these analyses.

The following sections each relate to a stage in the methodology.

2.2. Mapping food retail access in Scotland

2.2.1. Data on retail provision

There is no comprehensive list of stores and other retail outlets that sell food in Scotland. The project collected data from a variety of sources to provide as full a map as possible on the location of food stores and other outlets selling food (excluding takeaways and coffee shops). The project formed a national view of Scottish food retailing (the national food retail store database) was formed as of July 2005.

The view was formed through combining industry data from the Institute of Grocery Distribution (IGD) with commercial lists from Marketscan and Catalist. These data were then updated using company websites of the major multiples, direct contacts with major firms, Yell.com and websites of symbol groups (e.g. Londis and Spar). In addition, to verify inter-company transfers of ownership, for example from Safeway stores to Morrisons[1] and then to Somerfield, a Competition Commission listing was obtained and over 30 stores were contacted individually. Records were sorted on postcode and then inspected.

Data from local authorities were sought. These varied widely in availability, recording method and accuracy. The data that were supplied from local authorities for the 2005 database were in as many different formats as there were councils supplying it. Some supplied it only on paper; some supplied it with no postcode; some supplied it with no indication of store type; and many had very unstructured address data fields which meant postcode verification and checking was problematic. It was also found from on the ground surveys that all the relevant authority databases had varying degrees of over representation in the data. This included not only inaccuracies of food stores, e.g. some present on ground but not in the list and vice versa, but, in some cases, a number of non-food retail establishments such as cafes, restaurants, care homes, schools, etc. were wrongly identified as food stores. These data were an adjunct to the more direct sources listed above but were not used as a major source.

Data were initially cleansed focusing on postcode validity by joining with the OS Code-Point data (see Appendix 3) and identifying which records had postcodes that could not be grid referenced. Postcode validity was improved through using the Royal Mail online postcode/address checking service which operates against the current PAF (Postal Address File).

2.2.2. Type of shop

There is no agreed standard naming convention for the definition of different types of food shop. Many terms are used inter-changeably, e.g. a convenience store can also be called a grocer or a general store or a minimarket etc. With data being sourced from a number of different routes the categorisation issue was further complicated. It was decided to use a clear and unambiguous classification scheme that also afforded comparability with other analyses.

Food stores were divided into the following types:

- stores selling a wide range of food products – general food stores;
- stores selling a narrower range of food products, but in some depth – specialist food stores;
- and food secondary stores – a store in which food is present but as a secondary range e.g. in confectioners and newsagents.

[1] The name of the company is Morrisons, with no possessive apostrophe, although the family name of the founder is Morrison.

The general food stores type includes supermarkets, grocers, hypermarkets, convenience stores, freezer centres and discounters. The specialist type includes butchers, bakers, fishmongers, greengrocers, market stalls and delicatessens. Non-food stores include newsagents, confectioners and off-licences.

The general food stores were further divided, using sales area figures, into the following sub-types:

- small general food store with less than 3,000 sq ft selling area;
- medium general food store between 3,000 - 15,000 sq ft selling area;
- and large general food store of greater than 15,000 sq ft selling area.

This classification of general food stores matches that used by the Competition Commission for its inquiries into the store transfers between Safeway, Morrisons and Somerfield.

2.2.3. Retail provision database update

The national food store retail database was updated in September 2006 utilising a number of sources (see appendix 2). Data were sourced from IGD and Marketscan again. Company websites were re-inspected to ensure that the data were current.

The data sourced from Catalist in 2005 were found to be overly optimistic concerning the level of food retail provision. It was claimed that a number of the petrol filling station forecourt stores (PFS) sold "a wide range of groceries sufficient for an evening meal", but the data did not in fact provide this with some listings being petrol only outlets. It was also found that typically those PFS operations that did provide a level of food retailing were already recorded from other datasets. The Catalist data therefore were not used in the updating.

Due to the issues highlighted above Local Authority data were also not used in updating.

The national maps of food retail provision as of September 2006 are shown in Section 3 of this report.

2.2.4. Data on spatial frameworks

There were a number of communities in Scotland that the project needed to cover adequately in order to ensure that the key questions and objectives of the project were met in a way to provide useful data to inform policy.

For the purposes of the project it was decided that these communities could best be defined in terms of their location in physical space (urban or rural areas), their deprivation levels (Scottish Index of Multiple Deprivation) and indicators of community 'accessibility'. A distinction has been made, when looking at these definitions, between those that can be clearly defined by geographic boundaries and those that are less clearly spatially delineated.

There are a wide range of different geographies that could have been used by the project. A number of factors need to be considered in selecting project geographies:

- resource limitations dictated that a subset of these must be chosen;
- planned reporting and analysis purposes:
    - the uses to which the research will be put;
    - the desired balance between an investigative study and a reporting "atlas production" approach;
- commonality to enable widespread reporting and comparability with other work; and

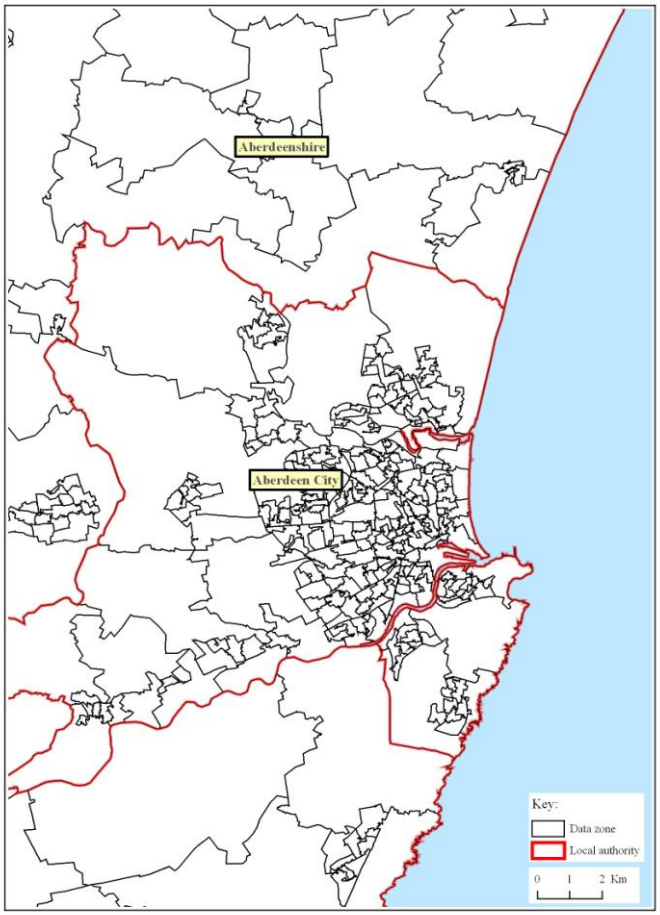
- stability to enable consistent comparisons over time – especially if the concept of an ongoing sentinel study is accepted.

The postal geography (post codes) (see appendix 3) allow a high resolution of analysis and is the foundation for geo-locating the retail provision database as constructed. It is less accurate in rural areas. The sentinel studies in rural areas allow comparison of the accuracy of postcode location with other techniques such as GPS. If the retail provision database is to be maintained beyond the length of the project then consideration must be given to maintaining the postcode-geolocation accuracy.

The data zone level was a key geography on which to focus as it offered stability and commonality along with a relatively high degree of resolution compared with previously commonly used geographies such as council wards. The data zone geography is important, in particular, in that the Scottish Executive urban-rural classification (SEUR) and the Scottish Index of Multiple Deprivation (SIMD) are mapped to it. Data zones are the core small-area statistical geography for dissemination of results by the Scottish Neighbourhood Statistics (SNS) service. Information contained within data zones are derived from the 2001 Census. These small areas nest within local council areas and are built up from 2001 Census output areas. Data zones were developed to a stable and consistent geography which can be used to analyse changes over time. There are 6505 data zones across Scotland with a mean population of 778 (range 500 – 1000).

Figure 1 below uses Aberdeen and the surrounding region to illustrate the data zone geography.

Figure 1: Data zones in and around Aberdeen



As can be seen from the map, data zones cover larger geographic extents in rural areas and smaller geographic extents in urban areas, with the aim being to create roughly similar sized zones in terms

of population. The urban-rural classification was important for analysing retail provision and was a key factor in sentinel site selection (see section 2.3 below).

The healthcare orientated geographies were more problematic. Reporting at health board level was feasible and potentially at the lower Community Health Partnership (CHP) level if clear mapped definitions (digital boundaries) had been available, but at the time of this study they were not available. Appendix 3 provides more information.

2.3. Sentinel selection

2.3.1. Introduction

The retail provision of healthy food was assessed through surveys carried out in sentinel areas. Sentinel areas were sets of contiguous data zones. The sentinel sites were selected to obtain a representative sample of food shopping that would allow an understanding of the determinants of food price and availability in a range of settings across Scotland. A two-stage stratified sampling approach was employed.

A key objective of the work was to understand healthy food access issues for consumers on low incomes and those living in rural areas. It was seen that deprivation varies more widely, in a local geography, than the urban-rural classification. The urban-rural classification from the Scottish Executive is provided as a six-point classification (see Appendix 3.d). To enable comparison between the two schemes SIMD has been shown in Figure 2 below also in a six-point scale. Figure 2 illustrates the variation in both these variables across Fife using a six point scale.

It can be seen that the top map (SIMD) shows a more varied pattern and mix of colours and areas than the bottom map (SEUR). It is easier to define the boundary of a sizeable contiguous area that is just one or 2 colours on the SEUR map than the SIMD map. That is a sentinel that is clearly homogenous for SEUR, i.e. just 1 or 2 types of SEUR, is more easily drawn than a clearly homogenous sentinel for SIMD.

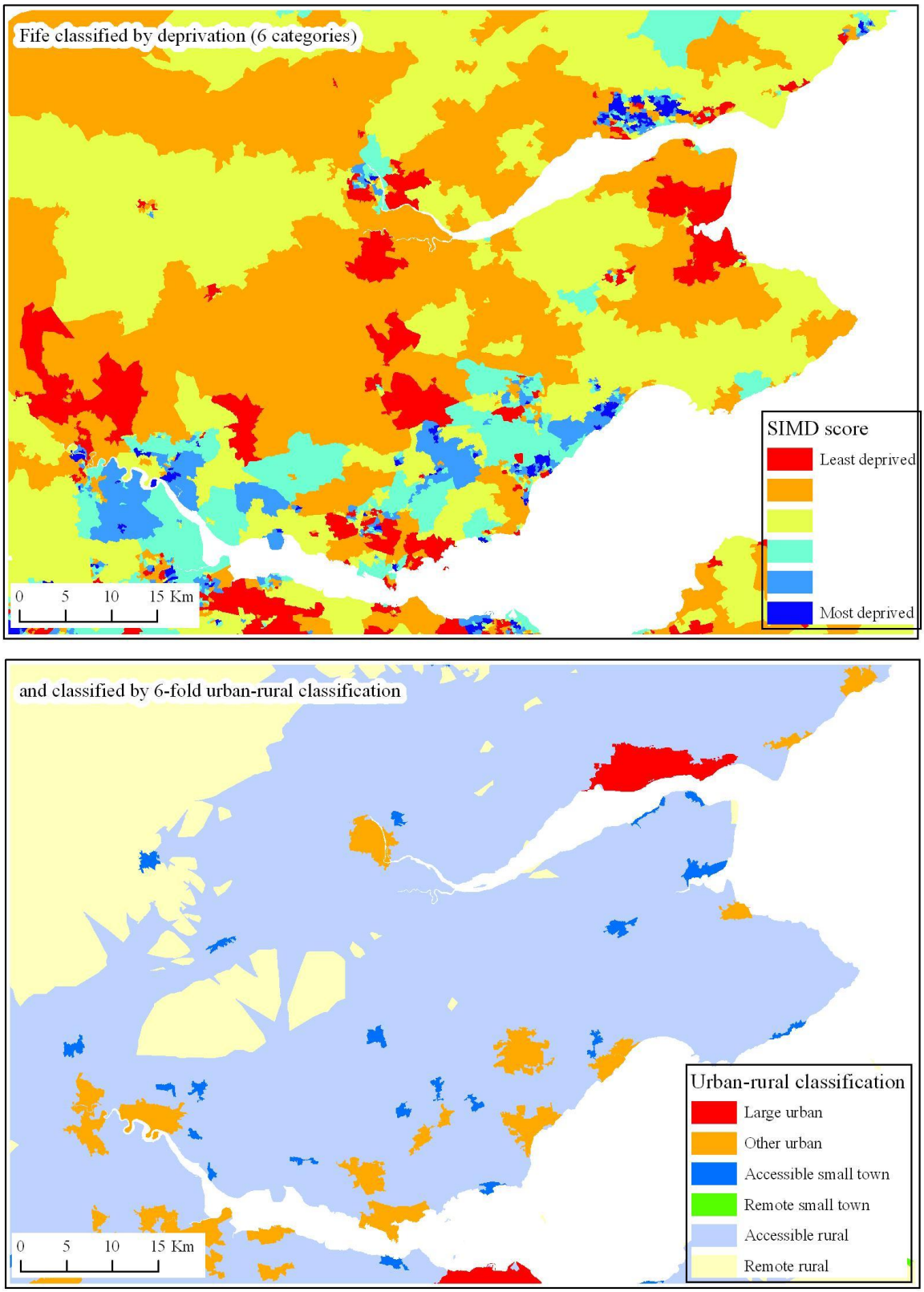
It was therefore decided to use the Scottish Executive six-fold urban-rural classification (SEUR) as the primary stratification mechanism for sentinel selection with the secondary stratification being by deprivation. Sentinels were selected first on the basis of their SEUR value and then as being affluent or deprived. Both of these dimensions were directly related to the data zone geography of Scotland which allowed a precise definition of sentinel areas at quite a high level of resolution, approximately to the nearest 750 people.

The list of settlements provided by the General Register Office for Scotland (GROS) was considered as a sampling frame but this was discarded because:

- many shops lie beyond settlement boundaries;
- settlement boundaries are not stable over time;
- larger settlements would be too large to manage as an individual sentinel site.

It was intended that sentinels based on data zones would provide a stable geography for potentially longer term research. Their deprivation characteristics were defined based on SIMD 2004 data, the current version at the time of definition. SIMD has been updated (SIMD, 2006) which has affected the characteristics of some data zones but the underlying geography, i.e. data zone boundaries, has remained constant.

Figure 2: Comparison of SIMD and SEUR spatial heterogeneity



2.3.2. Methodology

To select the sentinels the 6505 data zones within the six-fold Urban-Rural classification were divided into three types of environment:

- **Urban** [classifications 1 and 2]
- **Small towns** [classifications 3 and 4]
- **Rural** [classifications 5 and 6].

Within each of these environment types the data zones (DZs) were then stratified into deciles of relative deprivation (SIMD).

In the top and bottom deciles within each type, data zones were then further stratified into quintiles by deprivation. One DZ was then randomly selected from within each quintile. In effect one DZ for the extreme 2%; one DZ for the extreme 3 and 4%; one DZ for the extreme 5 and 6% and so on. This produced a list of five data zones as potential candidates for the sentinel representing that type of urban-rural environment and deprivation mix.

One data zone was then selected from each list of five to act as the nucleus of the sentinel for that mix – i.e. one for urban deprived; one for urban affluent; one for small town deprived and so on. Table 1 summarises the selection of the six nuclei.

Table 1: Sentinel nuclei selection strategy

	Urban	**Small Town**	**Rural**
Deprived [bottom 10%]	One DZ chosen from a stratified random list of 5	One DZ chosen from a stratified random list of 5	One DZ chosen from a stratified random list of 5
Affluent [top 10%]	One DZ chosen from a stratified random list of 5	One DZ chosen from a stratified random list of 5	One DZ chosen from a stratified random list of 5

For each of the six nuclei DZs additional data zones were added to construct an overall sentinel area consisting of contiguous DZs. The initial selection and judgemental data zone addition were based on a variety of criteria:

- identifying a clear grouping of data zones that satisfy the desired characteristics (relatively homogenous);
- including a significant number of retail outlets to survey;
- producing a final set of sentinels that represents the whole country;
- achieving an overall mix of data zones that are representative of the key dimensions of definition.

The sentinels were designed to enable a complete census of retail provision to be carried out within each one. A census gives more powerful data as it validates the accuracy of the data collected remotely at a national level. Survey work capacity can be easily matched to activity through controlling sentinel size.

The initial six sentinels constructed were:

1. Urban Deprived = Scotstoun/Drumchapel (Glasgow City)
2. Urban Affluent – Broughty Ferry (Dundee City)
3. Small Town Deprived – Kilbirnie (North Ayrshire)
4. Small Town Affluent – Ellon (Aberdeenshire)
5. Rural Deprived – Dornoch (Highland)
6. Rural Affluent – Annan (Dumfries and Galloway).

The number of shops in the national database to be surveyed from this procedure was calculated to be 175. Once an estimate for missing units was included, the total number surveyed within these areas was projected to be approximately 250. This was felt to be insufficient to provide enough data to allow a thorough representation of the issues. A target of 450-500 was considered more suitable and sufficient to enable detailed analyses.

This larger survey count could have been achieved either through constructing larger sentinel areas or by defining additional sites for certain types of environment-deprivation mix. It was decided that the latter option was preferable as expanding the sentinel would dilute the character (extremes) of the sentinel. It also allowed island sentinels to be specifically included.

No island candidate data zones had been generated in the stratified sampling procedure shown in Table 1. It was found that island data zones were predominately in the middle of the deprivation scale and therefore had a nil chance of being selected as they were considered neither particularly deprived nor particularly affluent.

Surveying an island group was thought to bring the benefit of increasing the proportion of remote rural areas being surveyed and would additionally introduce remote small towns to the overall survey mix. Orkney was proposed as a potential island sentinel as its rural and small town areas represented the widest range of deprivation found across the islands. Eilean Siar had a more deprived and slightly more rural profile than Orkney. Both island groups had much higher estimated shop counts than the other sentinel areas and would significantly increase the overall project shop count.

Inverness was also added as a sentinel as it had the benefit of including the SEUR type 'Urban(other)' into the overall mix and it would provide buffer[2] stores for the RD1(Dornoch) sentinel. See section 2.5.7 for more information on buffer stores. Inverness represented a community with a very substantial hinterland of shoppers. Cupar was added as an additional small town affluent site, within the small town affluent sentinel, as Ellon on its own was thought to have too few units to provide a representative survey of this type of community.

Finally it was decided that the rural-affluent sentinel would be based on Haddington in East Lothian rather than the initial option of Annan. Haddington, and its environs, was thought to provide a larger number of shops to act as a rural affluent sentinel on its own compared to Annan. It also had a remote small town element.

2.3.3. Sentinel profiles

The methodology described above resulted in the 9 sentinels detailed in Table 2 being produced. Sentinel ST2 consists of 2 different towns: Ellon in Aberdeenshire (termed ST2e) and Cupar in Fife

[2] A store outwith a sentinel area but offering a food shopping option for consumers resident within a sentinel.

(ST2c). Sentinel ST1 consists of 4 distinct towns (Kilbirnie, Beith, Dalry and Lochwinnoch) however they are all geographically close and were considered one site for surveying.

Detailed definitions and profiles of the sentinels are provided in Appendix 5.

Table 2: Sentinel sites constructed

Urban/rural type	Relative Deprivation	Sentinel code	Sentinel name	Estimated shop count	Median SIMD decile	Interquartile SIMD range
Urban	Deprived	UR2	Scotstoun/Drumchapel	100	9	8 to 10
Urban	Affluent	UR1	Broughty Ferry	50	2	2 to 4
Urban	Mixed	UR3	Inverness	83	4	3 to 7
Small town	Deprived	ST1	Kilbirnie	33	7	5 to 8
Small town	Affluent	ST2e	Ellon	15	1	1 to 2
-	-	ST2c	Cupar	16	2	1 to 4
Rural	Deprived	RD1	Dornoch	37	6	5 to 7
Rural	Affluent	RA1	Haddington	60	3	2 to 4
Island	Mixed	IS2	Orkney	66	4	3 to 5
Island	Mixed/deprived	IS1	Eilean Siar	68	7	6 to 7
			Total	528		

The 10% most affluent data zones comprise SIMD decile 1. The 10% most deprived data zones comprise SIMD decile 10.

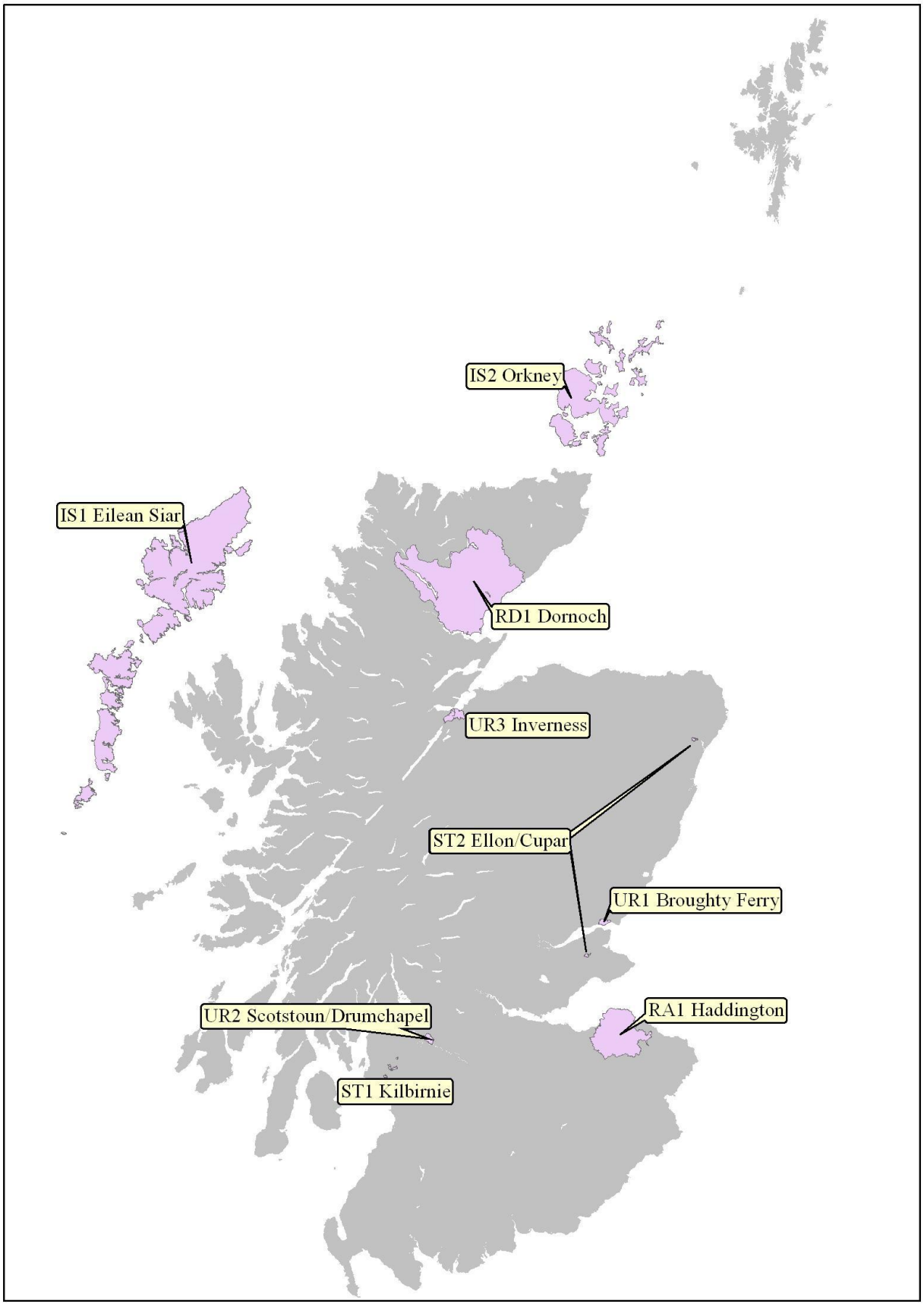
A comparison of the sentinel's urban-rural profile with the national profile is shown in the table below. Table 3 shows that other urban and accessible rural areas are somewhat under-represented and small towns and remote rural are somewhat over-represented in terms of areas being surveyed. However, since many accessible rural consumers partly shop in small towns and urban areas it was felt that the mix used was a satisfactory representation of environments for the specific purpose of this project.

Table 3: Total sentinel urban/rural mix

Environment	Sentinel %	National %
Urban large	37.6	37.4
Urban other	15.1	29.1
Small town accessible	15.7	10.2
Small town remote	7.3	2.9
Rural accessible	5.4	14.3
Rural remote	18.9	6.1

Figure 3 shows the location of sentinels.

Figure 3: National distribution of sentinels



2.4. Healthy eating indicator shopping basket

2.4.1. Previous work

This section of the report summarises the design logic and final product composition of the healthy eating indicator shopping basket (HEISB). A number of issues and objectives were considered in defining the composition of the healthy basket:

1. The basket was **limited** to 35 products because of practical fieldwork and analysis resource constraints;
2. Products chosen had to allow valid **comparisons** with previous research projects;
3. Products chosen had to be **relevant** to Scottish consumers, by including aspects of familiarity, cost, tradition and convenience;
4. Some products needed to be more common to facilitate extensive price comparisons across Scotland, i.e. to help address **affordability** as an issue;
5. Some products needed to be less common, and therefore be more discriminating in identifying the **availability** of healthy food;
6. Products needed to represent a **balance** and range of different food groups.

To satisfy these objectives products were selected to create a basket of **indicator** products, rather than a more representative total weekly household basket, as was the case with other projects (Cummins and MacIntyre 2002, Donkin *et al* 1999). The White FSA study (White *et al*. 2004) used a list of 33 food items covering a spectrum of healthier, neutral and less-healthy food statuses. The emphasis of this work with 35 items is focused on healthy food, affordability and choice.

The basket was limited to healthy eating indicators with 'health discriminator' capacity and does not include less healthy eating options. This is in line with the objectives of the project to look at the availability and affordability of healthy options in a series of focused study areas (sentinels) across Scotland. The selection of items was informed by careful consideration of their nutritional composition in line with existing dietary guidelines and recommendations.

2.4.2. Basket composition

The indicator basket is based on the Balance of Good Health (BOGH) and the Scottish Diet Report and took into consideration the FSA work on nutrient profiling, diet variety and quality, health discriminators (e.g. brown rice etc), national eating habits, local taste, familiarity, cost and convenience of foods. The selection of items provides a representation of all the major food groups with an emphasis on fruit and vegetables. This inclusion of more fruit and vegetables acknowledges the interest in fruit and vegetables as an essential element of a healthy diet and the focus of previous work on Scottish diet (Scottish Office, 1995; Anderson *et al*, 2007). Table 4 summarises the food group composition of the basket.

Table 4: HEISB by food category

Food Group	Count
Fruit and vegetables	17
Carbohydrate rich	9
Protein rich	4
Dairy	3
Fatty/oily foods	1
Ready meal	1
Total	**35**

Table 5 to Table 10 provide detail of the products in the basket and identify the specific reasons for a product's inclusion in the basket. The composition of the basket drew on previous studies in the area of food availability and affordability across a range of different countries. This included research on food baskets from the USA (Cohen 2002) and Australia (Burns et. al. 2004) reflecting current dietary recommendations, actual preferences, popular foods and food prices. Specific UK studies looked at involved basket compositions that were designed to reflect ethnic preferences (Donkin *et al* 1999), or regional preferences (Sooman *et al* 1993, Anderson *et al* 1993, Cummins and McIntyre 2002, Mooney *et al* 1990, White *et al*, 2004). Collectively these included popular foods, baskets representing a 'modest but adequate diet', common household items, or those foods recommended as part of a healthy diet. The work of White, *et al* (2004) in Newcastle, England, has been chosen for specific comparison as being the most relevant and recent body of work in this field.

The initial HEISB list was drawn up and circulated among the research team for consultation until a preliminary selection of items was identified. The products were organised into categories reflecting store merchandising to aid data collection in the field.

The importance of convenience foods to today's consumer is also included through a ready meal and oven chips as well as the existing frozen peas (convenience). In addition a number of branded items were included to allow a price comparison across the survey sites (price focus). Considerable time was spent discussing substitute items and agreement reached on the need to restrict the list to items that were of comparable nutritional status, allowing for size variation, and opting for lowest priced items unless specific brands were indicated on the list.

The list represents the final selection of items chosen after the meeting with FSA nutritionists to discuss the products to be included in the pilot stage of the survey. A number of items were dropped from the list including oatcakes, eggs, and olive oil. Others were added to the list – long grain white rice, tinned sweetcorn, tinned pineapple, oranges and lean mince.

Table 5: Fruit products in the HEISB

Product Name	Product Description	Target size
Apples	Fresh loose eating apples – green or red (not cooking apples)	per kg
Bananas	Fresh loose medium sized	per kg
Grapes (white)	Fresh un-seeded loose	per kg
Oranges	Fresh loose	per kg
Orange Juice	Pure UHT orange juice	1 l
Pineapple	Tinned pineapple in own juice	220 g tin
Frozen berries	Frozen raspberries or frozen berry mixture	454g

Table 6: Vegetable products in the HEISB

Product Name	Product Description	Target size
Onions	Medium sized brown onions loose	per kg
Carrots	General purpose loose carrots	per kg
Broccoli	Loose unprepared broccoli	per kg
Lettuce	Round variety	single loose
Peppers	Common red capsicums	per kg
Tomatoes	Loose standard medium-sized tomatoes.	per kg
Cucumber		single loose
Sweetcorn	Low salt and low sugar tinned sweetcorn	198 g tin
Baked Beans	Ordinary baked beans tinned in tomato sauce.	420 g tin
Peas	Frozen garden peas or petit pois	907 g

Table 7: Carbohydrate products in the HEISB

Product Name	Product Description	Target size
Potatoes	White loose general purpose	per kg
Weetabix	Weetabix wheat cereal only as has a known healthier sodium level.	24 pack
Porridge oats	Plain dry, unsweetened, unflavoured oats	1 kg
Bread rolls	Brown bread rolls 100% wholemeal flour	6-pack
Bread loaf	Medium sized 100% wholemeal flour pre-sliced bread loaf	800 g
Pasta	Dry 100% durum wheat flour spaghetti	500 g
White rice	Long grain normal cook white rice	500 g
Brown rice	Normal cook brown rice	500 g
Oven chips	Oven chips, < 5% fat by cooked weight	907 g

Table 8: Protein products in the HEISB

Product Name	Product Description	Target size
Chicken	Fresh chicken breasts, no skin, no bone	2-pack
Beef	Fresh beef mince lean, ideally < 7% fat.	500 g
Salmon	Fresh salmon fillets	2-pack
Haddock	Fresh haddock fish	2-pack

Table 9: Meal product in the HEISB

Product Name	Product Description	Target size
Ready meal	Birds Eye Lasagne	400 g

Table 10: Dairy products in the HEISB

Product Name	Product Description	Target size
Semi-skimmed milk	Semi-skimmed milk	1 lt
Skimmed milk	Skimmed milk	1 lt
Yoghurt	Low fat fruit yoghurt	125 g
Spread	Low fat spread. Made from PUFA maximum fat content 41%	500 g

Three additional fruit items have been added compared with White, increasing the total to six, to emphasise the importance of fruit within the diet and allow a particular local sourcing option (frozen berries). The number of vegetable items has been maintained at nine with the substitution of tinned low salt and low sugar sweetcorn for tinned tomatoes. Again this increases the healthy choice aspect as fresh tomatoes were already present in HEISB. The major difference with the White study is substituting White's "Less Healthy" with "Wider Healthy" and substituting neutral with convenience healthy foods.

In comparison with White (Table 11) the overall number of items is very similar: White (33) and HEISB (35). There is commonality with 19 products being the same in both baskets, i.e. 54% of the total HEISB. The major difference has been to substitute White's paired "Less Healthy" and "Neutral" items with a set of additional healthier other foods. This has allowed the Scottish basket to incorporate the Scottish dimension as well as evaluate choice, and convenience, within healthy food. So for example the White basket included "Chicken" and "Sausages" whereas the Scottish basket has "Chicken" and "Beef mince lean". The White basket had "Weetabix" and "Frosties" cereals; the Scottish has "Weetabix" and "Porridge oats". White had "Tuna" and "Tinned meat"; Scottish has "Haddock" and "Salmon".

Table 11: Comparison of HEISB with White study

Foods with shading are found in both baskets. Foods with shading are in HEISB only.
Foods with no shading are White only.

Fruit	Vegetables	Healthier other foods	Scotland	White Less healthy	White Neutral
Apples	Tomatoes	Chicken	Beef mince lean	Sausages	Cheddar
Oranges	Cucumber	Tuna	Haddock	Tinned meat	Eggs
Bananas	Lettuce (round)		Salmon		
Grapes (white)	Peppers (red)	Yoghurt (low fat)	Low fat spread	White sugar	
Strawberries	Broccoli	Semi-skimmed milk	Skimmed milk	Whole milk	
Pineapple (tinned in own juice)	Carrots	Wholemeal bread	Wholemeal rolls	White bread	
Berries (frozen)	Onions	Weetabix cereal	Porridge oats	Frosties cereal	
	Peas (frozen)	Fruit juice	White rice	Carbonated drink	
	Sweetcorn (tinned, low salt and low sugar)	Baked beans	Brown rice	Crisps	
	Tomatoes (tinned)	Pasta	Potatoes (standard)	Biscuits	
			Potatoes (frozen oven chips)		
			Ready meal	Kit Kat	

2.4.3. Substitute products

The main rationale for the use of substitute products was to maximise nutritionally valid data collection and ensure fieldwork was practicable, whilst maintaining the purpose and logic of the HEISB. In particular the key aim was to survey healthier affordable products.

Hence any type of 100% durum wheat dry pasta was surveyed, not just spaghetti, because nutritionally and price wise there is little difference between varieties. But 'Tropicana' juices and 'Uncle Ben's' rice were not surveyed because they were deemed too expensive. New potatoes were also not surveyed because they were thought likely to be too expensive compared with ordinary white potatoes at the time of year of the survey. Smoked salmon was not allowed as a substitute for

salmon for both nutrition and affordability reasons. Battered haddock was not allowed as a substitute for haddock on nutrition grounds.

Table 12 below details the substitute products used with explanations where relevant.

Table 12: Substitute products used

Food Item	Description of main choice	Preferred Weight or Unit	First substitutes	Second substitutes
Apples	Fresh loose eating apples – green or red (excluding cooking apples).	Per kg	Pre-packed eating apples	
Bananas	Fresh loose medium size.	Per kg	Small or large size loose.	Pre-packed.
Grapes (white)	Fresh unseeded loose or packaged ("White" grapes are the pale green ones in actual colour)	Per kg	Seeded white grapes	Red or black grapes (seeded or unseeded).
Oranges	Fresh, loose, medium orange.	Per kg	Pre-packed medium oranges.	Other e.g. tangerines, satsumas, clementines, record variety.
Pure orange Juice -UHT	UHT (from conc) 100% pure orange juice.	Per litre	Fresh (from concentrate)	
Premium juices, e.g. Tropicana, were not surveyed because they were deemed too expensive.				
Pineapple	Tinned - canned in own juice	227g tin	Any other size of tin	Other canned fruit in juice
Frozen berries	Frozen raspberries. (to reduce the effect of seasonality)	454g	Frozen berry mix	
Onions	Medium sized brown onions, loose.	Per kg	Large brown loose onions.	Pre-packed brown onions.
Carrots	General purpose, loose, medium size.	Per kg	Pre-packed general carrots.	Frozen carrots.
Broccoli	Fresh, loose	Per kg	Pre-packed.	Frozen
Lettuce	Fresh single round lettuce	Per lettuce	Iceberg	Other type, record variety
Red Pepper	Fresh loose common red capsicum.	Per kg	Loose green pepper.	Pre-packed peppers.
Tomatoes	Fresh loose medium sized, general tomato.	Per kg	Pre-packed medium	Other fresh tomato – record variety.
Cucumber	Fresh, single cucumber.	Per cucumber	Cucumber portions	
Sweetcorn	Tinned Low sugar/low salt	198g tin	Any other size of tin	Other low sugar and low salt canned vegetable – record type.
Baked Beans	Ordinary baked beans in tomato sauce.	415g tin	Any other size of tinned baked bean.	Other tinned beans (not with meat) – record type.
Peas	Frozen bagged peas or petit pois.	907g	Any other pack size	Any other frozen veg.
Potatoes	White general purpose, loose.	Per kg	Pre-packed general purpose white potatoes.	Red potatoes – loose or packed.
New potatoes not surveyed because they were likely to be too expensive compared with ordinary white potatoes				
Weetabix	Weetabix wheat cereal only	24 pack	12, 36, 48 or 72 pack.	
Porridge oats	Plain dried oats- no additions or flavours	1 kg pack	Other pack size	Loose.
Bread rolls	Brown rolls. Made from 100% wholemeal flour	Six pack	If not 6 packs then individual rolls or price per roll for loose items	Any (brown) granary Rolls
Bread loaf	Wholemeal loaf Made from 100% wholemeal flour	800g loaf	Any other size of wholemeal loaf	Any other brown loaf
Pasta	Spaghetti (dry) 100% durum wheat	500g pack	Other pack size	Macaroni or other type dry pasta – record type.

Any type of 100% durum wheat dry pasta was surveyed, not just spaghetti, because nutritionally and price-wise there is no difference.				
White rice	Normal cook	500g pack	Other pack sizes including loose.	Basmati rice.
Premium rice brands, e.g. Uncle Ben's rice, were not surveyed because they were deemed too expensive.				
Brown rice	Normal cook	500g pack	Other pack sizes inc. loose.	
Oven chips	Low fat (less than 5% fat by served/cooked weight)	907g	Any other pack size	Any other oven chips
Chicken	2-pack Boneless, skinless breast	Per kg	Breast with skin on	Frozen breasts.
Beef	Beef mince labelled as lean or maximum 7% fat	Per kg	Any other pack size	Frozen lean or 7% fat beef mince
Salmon	2-pack Fresh salmon fillets	Per kg	Frozen salmon fillet	
Smoked salmon was not allowed as a substitute for both nutrition and affordability reasons				
Haddock	2-pack Fresh unbreaded haddock fillets.	Per kg	Frozen un-breaded haddock fillet	Breaded haddock (fresh or frozen)
Battered haddock was not allowed as a substitute on nutrition grounds				
Frozen ready meal	Birds Eye Frozen Lasagne Record type of ready meal, any weight variation	400g	Birds Eye Roast Beef dinner	
Birds Eye lasagne or roast beef dinner were the only known frozen ready meals that met the nutrition criteria.				
Semi-skim milk	Fresh 1 litre or 2-pints	Per litre	Fresh – another pack size	UHT
Skim milk	Fresh 1 litre or 2-pints	Per litre	Fresh – another pack size	UHT
Yoghurt	Low fat fruit Fresh – single pot	125g	Sterilised low fat fruit yoghurt.	Low fat plain yoghurt.
Spread	Low fat spread. Made from PUFA maximum fat content 41%	500g	Flora Light. Not Flora Original.	

A query arose over substituting any size of tinned bean for the 415g tin that was the HEISB product. Any other size of tin was allowed in the Surveyor's Notes however the price standardisation calculations resulted in two incidences of small tins being surveyed and high price per 415g unit values generated in the price standardisation process. It could be argued that the smaller tins of this item should not have been allowed as substitutes as they did not offer an affordable product when bought in quantity.

2.5. Survey methodology

2.5.1. Sentinel retail listing

Lists of the stores to be surveyed were generated through merger and cleaning of the relevant section of the national database with local databases specific to sentinel sites. The local databases used were obtained from the relevant local authorities along with listings for other specific commercial organisations such as for farmers' markets and local business websites. The local authority data are the names and addresses of registered food handling premises held for the purposes of complying with food hygiene regulations. As indicated earlier there was found to be a wide variation in the utility of the local authority databases.

Local authority data were found to be comprehensive but lacked discrimination. Whilst new premises get added to lists on a regular basis, deletions will be less frequently applied. A high number of non-retail food handling premises are included in their data such as cafes, restaurants, care homes and schools. In addition a number of the datasets were supplied with no postcodes.

It was noted that even company websites were often behind the reality of what was present in the field.

A number of the projects listed in SCDP were no longer operational.

A sample surveyor's store listing is shown in Appendix 8a. This listing is validated by the surveyor cross-checking the listing with the survey maps and with what is actually present on the ground.

2.5.2. Map production

Survey maps showing the location of listed food retail establishments were produced through plotting the store list data onto base map tiles and printing sheets out at a variety of scales. Two examples are shown in Appendix 6a. (Figures 4 and 5). Others are available on the associated web site.

The stores are geo-located primarily through using the Code-Point product (see Appendix 3). Certain locations were adjusted manually to improve understanding within specific survey maps such as within some rural and island areas where the larger dimensions of unit postcodes require specific points to be located more accurately. For example within an urban area a postcode may be no larger than a few metres and therefore premises can be located within this area very quickly. In rural/island areas a single unit postcode may cover many kilometres which can not be searched quickly by a surveyor.

The stores were uniquely numbered within each sentinel with a short integer. This facilitated quick and accurate map reading. This number, when used in conjunction with the unique sentinel ID, allowed unique identification of each store in the overall analysis.

2.5.3. Store and basket survey

The following Word and Excel documents were used in executing the surveys (see Appendix 7b):

1. Temporary Retail Surveyor job description;
2. Retail manager letter (English and Gaelic versions);

3. Summary of background, aims and objectives of the project;
4. Head office letter;
5. HEISB data collection form;
6. Notes on completion of HEISB form;
7. Notes describing the product-specific fresh produce quality scales;
8. Surveyor's FAQ sheet.

Appendix 6b. describes the job function of the surveyors used and the skills they require. Appendices 6b also provides material used in the initial approach by the surveyor at the time of the survey.

The original survey plan was to approach retailers at the time of the survey itself to request their permission to undertake data collection within their store. The pilot survey found that this was a feasible approach with no retailers refusing to participate or requesting that permission be sought from head office. However in the main survey some problems were encountered with this approach:

1. Contrary to the pilot experience a number of retail multiples requested that permission be obtained from senior management;
2. In the island areas it was found that more remote shops had completely closed days during the week and therefore could not be surveyed;
3. In addition staff in some smaller retailers requested that permission be sought from the shop owner who was absent and unobtainable.

The sequence of products on the form mirrored that most typically found within food stores. The form attempted to be quite specific without containing too much text. Surveyors were made familiar with the information in the supporting documents – the text on the form itself acts as a prompt. This specificity was an attempt to ensure comparability without being too restrictive.

Surveyors entered a unit weight and price and calculations were made in subsequent data processing to derive comparable price per unit weight figures.

A simple yet rigorous stock coding system was used as shown in Table 13.

Table 13: HEISB survey stock coding system

Code Recorded	Meaning	Further Survey Action
I	In-stock	Record price, and quality if relevant.
O	Out-of-stock, awaiting delivery.	Record price data only.
S	Not stocked but close substitute available	Record price, and quality if relevant, of substitute product.
X	Not stocked, no close substitute.	None, no further data recorded.

These codes were mutually-exclusive, i.e. a product could only ever be in one, and one only, of these four classes. At the data capture stage these codes were used with substitutes being sub-divided into pack, type or product. This was planned to allow further refined analysis but did not complicate the data collection task for the surveyors.

As the form was used further points of clarification were required. For example, if a pack was recorded then either a count of the number of items was required or the weight; 1 pack of oranges on its own was not capable of being analysed, so additional data were collected.

All surveyors undertook a training programme with instruction on how to complete the forms and conduct the fieldwork. Appendices 6 and 7 were used in training the surveyors.

2.5.4. Transport survey

To allow transport issues to be factored into consideration of access to healthy food, data were collected for each sentinel. The precise nature of the data depended upon the area and the scale being surveyed but some or all of the following sources were collected:

- road network;
- cycle network;
- pedestrian access including footpaths, underpasses, footbridges, etc;
- bus routes and timetables;
- ferry routes and timetables.

It was also necessary to collect information on transient and delivery based retail such as:

- general markets;
- farmers' markets;
- community food shops;
- mobile retailer routes and timetables, including e.g. fish vans;
- general internet food retailers.

There are also many specialist internet food retailers that could potentially have been used by residents of sentinels to place orders but this distribution method was considered to provide too niche route for the purposes of this research and would be difficult to survey.

2.5.5. Pilot survey

A pilot survey was established to test the methodology. Twenty-five shops were surveyed for the pilot [Midlothian – 12; Dundee – 11; Highlands – 2] covering a full range of sizes and types of shop from small local convenience stores, to travelling vans, frozen food retailers, supermarkets and specialist retailers. The pilot was undertaken in the second and third weeks of August 2005. Three surveyors were used. In addition members of the research team also made informal surveys. In general the survey and procedures held up well under field conditions.

A number of issues were raised as detailed in the report on the pilot survey (Appendix 7). The issues and the methods used to address them were used in subsequent surveyor training, in particular with the aim of obtaining consistency and to stress the need to provide comments on the survey form. The pilot helped refine the supporting documentation and survey method as well as providing useful input into the ways the data could be keyed and analysed.

2.5.6. Main survey

The initial plan for the main fieldwork was to conduct the sentinel surveys on a sequential basis moving from one area to the next. This would have enabled the main project researcher to act as lead surveyor with 1 or 2 field surveyors to assist. The main project researcher would have

conducted training and monitoring and managed the shop census. The field surveyors would have been responsible for the bulk of the in-shop surveys.

The HEISB contains 13 fresh fruit and vegetable products. Five of these, apples, oranges, potatoes, onions and carrots had been specifically included on the basis that they would provide a means for comparing affordability of healthy food across Scotland – i.e. a detailed analysis of geographic price variation of these products was planned. However it is widely appreciated that consumer prices for fresh fruit and vegetable products vary significantly over time. Seasonal (and shorter) temporal variations in supply affect availability and price as sourcing for differing products moves globally. Short term fluctuations in price also occur from week to week reflecting local and national market dynamics for any particular product.

Defining the HEISB and conducting the pilot highlighted two issues for the project.

1. within a sentinel the presence or absence of fresh fruit and vegetable products may be due to seasonal as well as geographic issues;
2. across Scotland variations in price may be due to seasonal and general temporal variations rather than geographic variations.

The initial surveying plan was not designed, or budgeted, to counter these issues. Addressing the impact of seasonality on availability would have possibly required sampling in the same sentinel at multiple points in the year. Reconsidering the schedule of surveying provided an opportunity to examine if it was possible to improve the data analysis by taking account of these issues.

It was therefore decided to conduct the sentinel surveys as closely together as possible within two main groups: one in October/November 2005 and one in February/March 2006.

2.5.7. Buffer selection

Sentinel boundaries were defined geographically as the boundary of a set of contiguous data zones. In some cases the boundary of a data zone is significant in defining a food shopper's behaviour, e.g. where the boundary coincides with a geographic boundary such as the coastline. In other cases the data zone, and hence sentinel boundary, have only administrative significance and have no impact on food shopper behaviour.

In these cases it was felt appropriate to selectively survey a sample of shops beyond the sentinel boundary to enable a fuller picture of food shopping options for sentinel residents to be produced. These shops were known as buffer stores, or simply buffers. The area from which they were selected was known as the buffer zone.

The nature of the sentinel and the number and range of shops found within the sentinel affected the decision process as to how many and what sort of stores were selected as buffers. The area surrounding a sentinel, and its provision of food retail stores, was of relevance. In general a variety of different types of food store were sought as buffer stores depending on what was available. Buffer surveys were also carried out in different areas around a sentinel depending on the overall variety of choice.

The buffer zones varied depending on the sentinel site. An approach to data collection of stores in these zones was established. Surveys were extended selectively into a buffer zone around sentinel areas. Buffer zones by necessity were larger in rural areas.

There was a trade-off between the size of a sentinel site, its buffer zone, and the percentage of units surveyed. Smaller sentinels received a higher rate of buffer store survey coverage. Sizes varied between urban and rural sites. The number of shops surveyed in total was intended to be around 500.

The final factor that influenced the buffer survey process was that of budget limitations. The final survey total was 564 surveys (3 of the surveys in UR3 act as buffers for RD1), compared with a target of approximately 500. Further buffer surveying would have had budget and schedule implications for the survey and all subsequent processes such as data capture and QA. Table 14 summarises the numbers of buffer stores and sentinel stores per sentinel.

Table 14: Number of buffer and sentinel stores

Sentinel ID	Buffer store	Sentinel stores	Total
IS1	0	60	60
IS2	0	42	42
RA1	15	64	79
RD1	13[+]	20	33
ST1	25	32	57
ST2	23	24	47
UR1	25	39	64
UR2	0	115	115
UR3	0	70[+]	70
Total	101	466	567

[+]3 stores were common to these two areas.

Appendix 8 describes the specific rationale for the choices of buffer stores for each sentinel.

The statistical analysis presented in this report refers to the 466 stores within the sentinel areas. The location of buffer stores and the availability of HEISB in them is shown in the graphical analyses but because they are outwith the sentinels, which were selected to reflect degrees of affluence-deprivation and urbanism-rurality, the buffer stores are not included in the statistical analysis and testing of relationships.

2.6. Data preparation

2.6.1. Data capture

The "Forms" feature of the relational database Access was used to capture the data collected on the survey sheets. Existing data were imported into Access using two pre-generated Excel files: one for the store information and one for the basket information.

The recorded survey data were then keyed into Access using two data-entry forms. These are templates that are designed to mirror the look of the paper forms and are populated using the pre-generated data. The two forms are shown in Appendix 11.

Data were keyed into the forms or options were selected from drop-down option lists. For example in the Store Data Entry Form "*Disabled access*" was answered as a tick box and "*Surveyor*" was selected from lists. The Sentinel ID is specific to the area being surveyed. The Store ID is specific to that store, within the sentinel area.

In the Product Data Entry Form "*Stock code*" and "*Produce quality*" were answered from lists. The closed structured nature of this type of data entry ensured quality and consistency within the data captured.

Access as a relational database can be used to answer queries and do basic analysis of the data. Excel or SPSS were more flexible for the price standardisation and more advanced analysis and data is easily exportable to them from Access.

2.6.2. Data processing

The detailed stages of the data preparation process are described in Appendix 11.

Due to the intended discriminatory design of the HEISB many products were not present to be surveyed. These should not be considered missing data. Their absence was an intended, and sought for, result. True missing data, e.g. when a product was present but perhaps its price was not recorded, were dealt with on a case-by-case basis.

Qualitative data on the type of promotion being run were used to derive a binary indicator field for quantitative analysis, i.e. either on a promotion of some sort or not on promotion.

The retail price at the time of survey was used for analysis as opposed to any price from which a promotion was claimed. Promotions are so widespread that they are the normal situation of retail prices.

Standard portion sizes from the Food Standards Agency were used to derive average price per unit (PPU) weight figures.

2.7. Analytical methodology

2.7.1. Analytical approach

Detailed statistical analysis was carried out using data from all the stores surveyed within the boundaries of sentinels. Buffer stores were selected judgementally and their inclusion, being outwith the defined sentinels, in the statistical analysis would have generated bias in the results. Buffer store data have been used, where appropriate, for the graphical analyses.

Much of the analysis presented here utilised univariate analysis such as simple frequencies, cross-tabulations and the presentation of means and medians. Parametric and non-parametric approaches were used, where appropriate, to estimate statistical significance. Multivariate analyses of food price and availability and were undertaken in order to investigate associations with sentinel location, area deprivation and shop category and used regression analysis.

In general, medians were used as the main outcome variable for price in the analysis as this was felt to give a more accurate estimation of the price by the variables of interests. Data were non-normally distributed and attempts to transform the data did not improve the non-normality of the distribution. Due to this extreme non-normality non-parametric tests were used to demonstrate statistical significance. Non-parametric statistical tests are distribution-free and are therefore appropriate for the data in this study.

Testing for statistical differences in total median basket price was not possible within the scope of work for this project. The HEISB was designed to discriminate between stores based on the range of healthier foods stocked and all types of food store were surveyed. As a consequence not all stores included in this survey stocked all the items in the HEISB. This means that a summary measure (total median basket cost) could not be calculated for each store and thus could not be statistically tested to see if total basket cost varied by the variables of interest.

Further analyses might impute values for the absent data in this survey by taking the mean or median value for an item by area and shop type. This would allow the calculation of a total basket cost for shops that might be reasonably expected to sell all items within the basket.

2.7.2. Food price

Bivariate analyses with individual item food price as a continuous variable were undertaken. Data were analysed by sentinel location, area deprivation and shop category with food prices standardised to a common weight to ensure comparability between items. As individual food item prices were extremely non-normally distributed, median values give a better indicator of price than the mean. Non-parametric Kruskal-Wallis tests were used to compare median price across the three independent variables.

In order to investigate whether area deprivation was a predictor of food price multivariate linear regression analyses were undertaken, controlling for sentinel location and shop category, on each individual food item in the survey. In each case p-values were reported. An identical approach was used for the paired analysis. Using a similar approach the proportion of variance in price explained by identified independent variables was assessed for each individual food item. This was done by entering each individual food item into a linear regression model which controlled for all independent variables and using the R^2 value to summarise the proportion of variance explained.

2.7.3. Food availability, promotions and quality

Bivariate analyses of food availability were undertaken with food availability as a binary categorical variable (available/not available). Data were analysed, as above, by sentinel location, area deprivation and shop category. For food groups median availability was used to describe availability by food group as data were not normally distributed, with the exception of ready-meals which only had one item in that group. For individual food item availability, proportions available were used and comparisons of the proportion available across categories in each independent variable were tested using Chi-Square, with a test for trend in the case of area deprivation. In each case p-values were reported. An identical approach was used for the paired analysis, promotions and quality.

3. RESULTS

A total of 466 food stores in nine sentinels across Scotland were surveyed between August 2005 and April 2006. The sentinel sites were selected to reflect the diverse residential environments, in terms of rurality and deprivation, which occur in Scotland. Data on the price, availability and quality of thirty-five food items were collected from all identified food retailers in each of these sentinel sites using a shopping basket tool developed specifically for the project (the Healthy Eating Indicator Shopping Basket). For details of this tool see section 2.4 of this report and Anderson *et al* (in press).

3.1. Food store variation

3.1.1. Key points

- Over half the stores surveyed were small general food stores and almost a third were specialists.
- Three sentinels did not contain a large general food store (i.e. a large supermarket/hypermarket "one-stop shop" type).
- Freezer centres were only found in urban areas and specialist greengrocers were only found in small town or accessible rural areas.
- In general the most deprived data zones have the greatest number of food retail shops located within them.

3.1.2. Types of food store surveyed

The types of stores surveyed are shown in Table 15. There were 310 general food stores of which 268 were small stores of less than 3,000 sq ft. These small general food stores were the largest single type of food outlet and made up 57.5% of the total sample. There were 13 large general food stores (>15,000 sq ft) and 29 medium general food stores (3,000 to 15,000 sq ft). There were also 141 specialist food stores - stores which concentrated on one type of product (such as greengrocers and fishmongers). There were also a small number of small outlets (15) that sold food, but where food was not the primary business.

Table 15: Types of food store surveyed

Type of Shop	Definition	Number of Shops	%
General Food Store:	Store where wide variety of food ranges stocked:		
- large	- net selling floorspace greater than 15,000 sq ft.	13	2.8
- medium	- net selling floorspace between 3,000 and 15,000 sq ft.	29	6.2
- small	- net selling floorspace <3,000 sq ft.	268	57.5
Specialist	Store where food range is limited but range(s) stocked in depth	141	30.3
Food secondary	Store where food is secondary to its main product ranges	15	3.2
Total		466	100.0

3.1.3. Types of food store by urban/rural

An ordered ranking of sentinel "urbanness", SEUR order, is derived from sentinel median SEUR and population density. That is large urban > other urban > small town > rural and then sentinels within equal SEUR types are ranked by population density.

Table 16 shows the distribution of food shop type by sentinel SEUR order. It can be seen that there is a wide variation in the number and type of food shops surveyed by sentinel. For example sentinels IS2, RD1 and ST2 contain no large general food stores. Sentinel RD1 contains no medium general food stores either. The other sentinels contain one large general food store apiece apart from UR2 which contains 4 and UR3 which contains 5.

Table 16: Food shop type by sentinel

Sentinel ID	UR2	UR1	UR3	ST1	ST2	RD1	RA1	IS2	IS1	
Sentinel environment	Urban D	Urban A	Urban M	Small Town D	Small Town A	Rural D	Rural A	Island M	Island M/D	
SEUR order	1	2	3	4	5	7	6	8	9	Total
Large general	4	1	5	1	-	-	1	-	1	13
Medium general	8	4	3	3	4	-	1	2	4	29
Small general	79	14	41	16	10	15	26	28	39	268
Specialist	18	16	19	12	10	4	34	12	16	141
Food secondary	6	4	2		-	1	2	-	-	15
Total	115	39	70	32	24	20	64	42	60	466

For descriptive purposes the shop type can be broken down into more specific types as shown in Table 17. Food secondary stores are not shown in this table. Freezer centres are both small and medium in size. Small multiple includes stores showing a symbol group fascia

Table 17: Detailed food shop type by sentinel

Sentinel ID	UR2	UR1	UR3	ST1	ST2	RD1	RA1	IS2	IS1	
Sentinel environment	Urban D	Urban A	Urban M	Small Town D	Small Town A	Rural D	Rural A	Island M	Island M/D	
SEUR order	1	2	3	4	5	7	6	8	9	Total
Large multiple	4	1	5	1	0	0	1	0	1	13
Medium multiple	3	3	2	3	3	0	1	2	3	20
Medium independent	0	0	0	0	0	0	0	0	1	1
Medium discounter	3	0	1	0	1	0	0	0	0	5
Freezer centre	5	2	1	0	0	0	0	0	0	8
Small multiple	27	4	24	7	7	13	13	8	5	108
Small independent	49	9	16	9	3	2	13	20	34	155
Butcher	6	3	4	2	0	2	4	7	7	35
Baker	7	6	7	5	5	1	4	3	2	40
Fishmonger	1	3	2	0	4	1	2	0	6	19
Greengrocer	0	0	0	2	1	0	7	0	0	10
Deli/health	2	3	6	2	0	0	5	2	1	21
Market/farm	2	1	0	1	0	0	12	0	0	16
Total	109	35	68	32	24	19	62	42	60	451

Whilst the cell sizes created by such a detailed categorisation are generally too small for meaningful statistical analysis some observations can be drawn.

Freezer centres were only found within urban areas. Greengrocers were only found within small town and accessible rural areas, i.e. the middle of the SEUR order scale. The large number of specialists within sentinel RA1 was partly due to both a Sunday market and a farmer's market being held during the survey period.

3.1.4. Sentinel food retail profiles

This section reviews the specific nature of the sentinels surveyed and reference should be made to the "Population and Food Retail Location" maps. Four maps are provided here to illustrate the pattern of store locations as typically mapped in the sentinels. The sentinels are listed as used in tables 16 and 17 above.

(1) UR2

Wide scattering of convenience stores and also distribution of larger general food stores. Planned shopping centres discernable with concentration of large general and specialist stores.

(2) UR1

Two discernable shopping centres – with concentration of small and medium general and specialist food stores. Large general food store situated in an "out-of-town" location.

(3) UR3

One main food shopping centre in centre with concentration of large general and specialist stores. Wide distribution of convenience stores.

(4) ST1

All types of food store present.

(5) ST2

No large general food store present.

(6) RD1

No medium or large general food stores present. Shopping centres consist of 2 or 3 small general food stores with possibly a specialist in small population concentrations.

(7) RA1

Two main shopping centres in small towns with other small general shops coinciding with concentrations of population. A number of specialists (farm shops and Sunday market stalls) were also surveyed across the sentinel. There were a number of survey refusals in this sentinel.

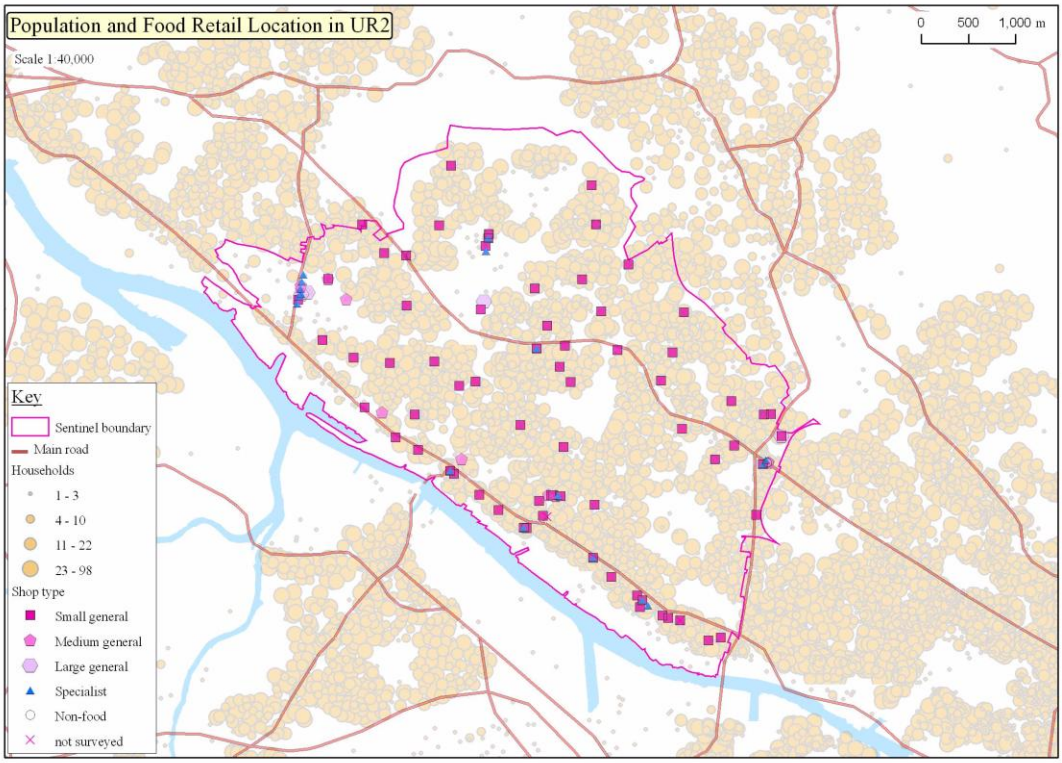
(8) IS2

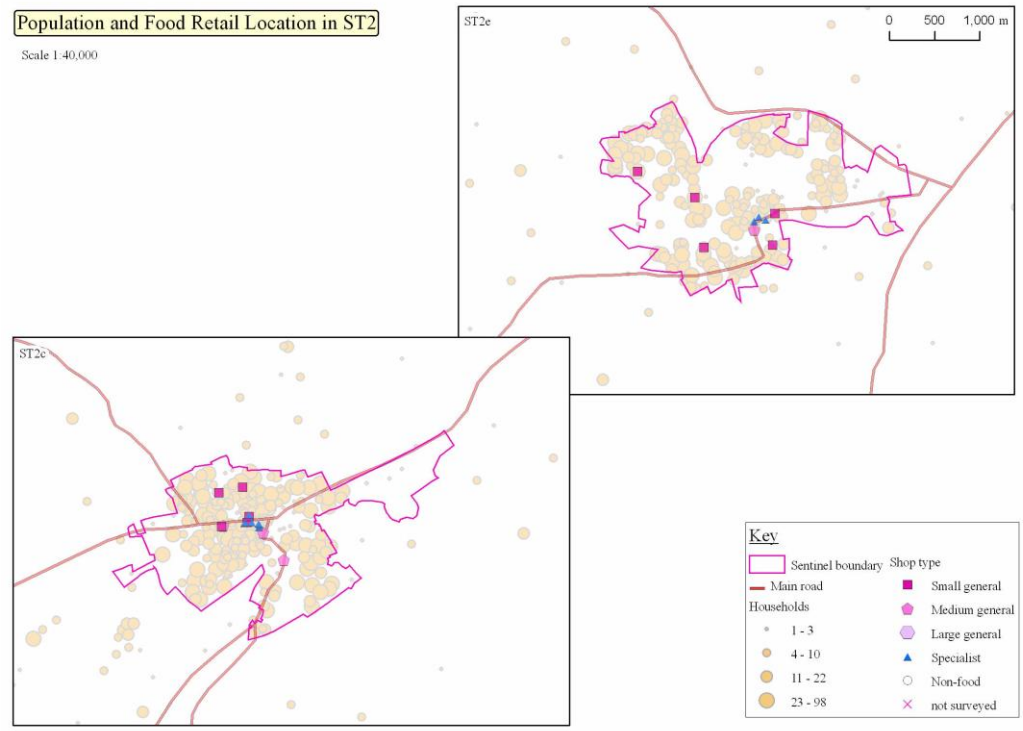
One main shopping centre and one subsidiary shopping centre on the main island. No large general food stores are present in these centres. Elsewhere there are small general shops and a few specialists distributed along coastal fringes and outlying smaller islands.

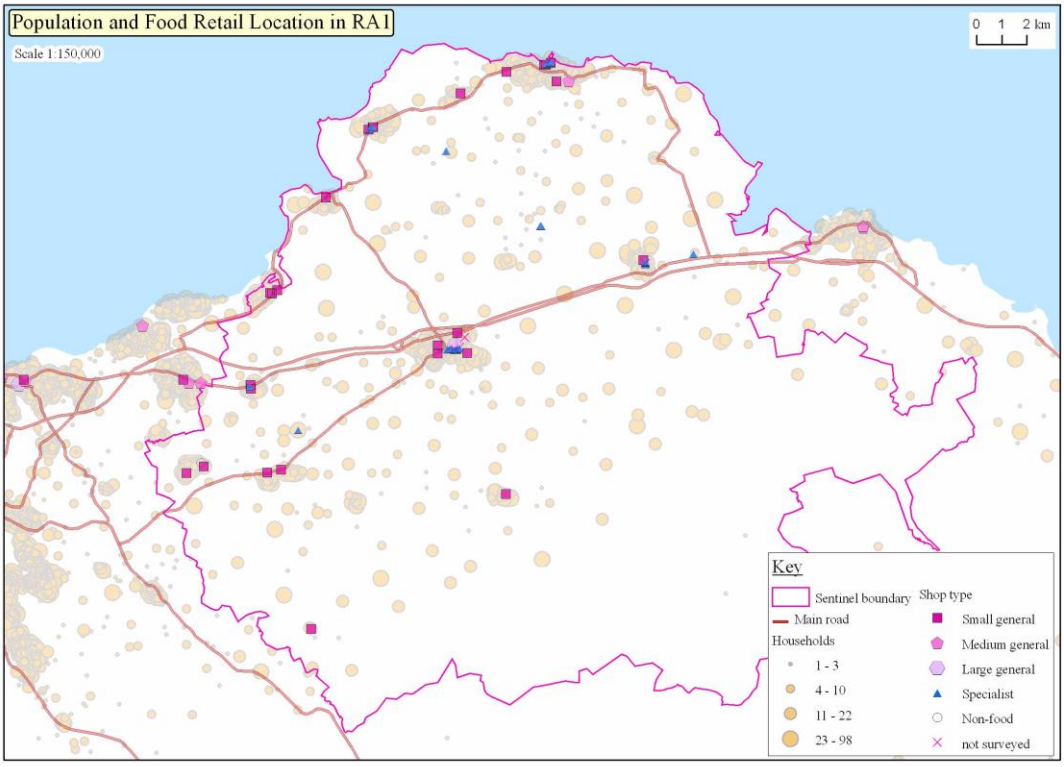
(9) IS1

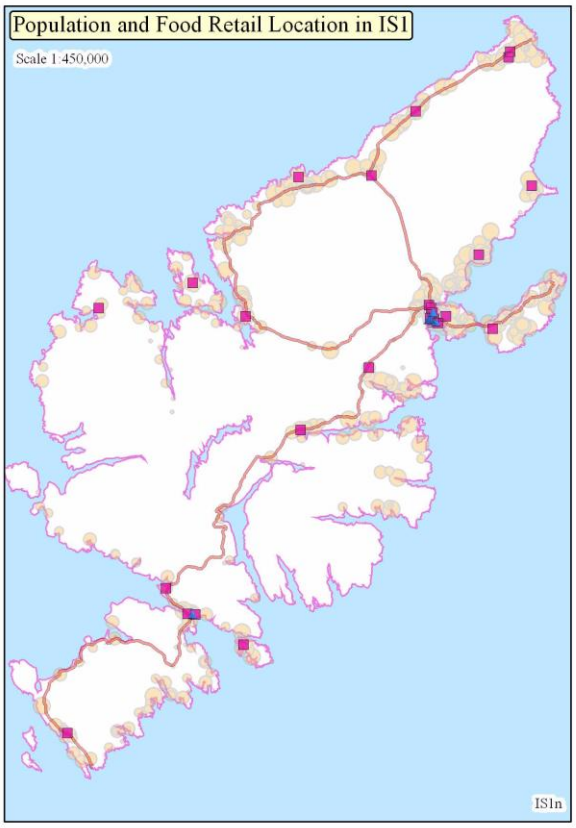
One main shopping centre on main north island containing a variety of small, medium and large general food stores and also some specialists. Elsewhere there are small general shops and a few specialists distributed along the populated coastal fringes.

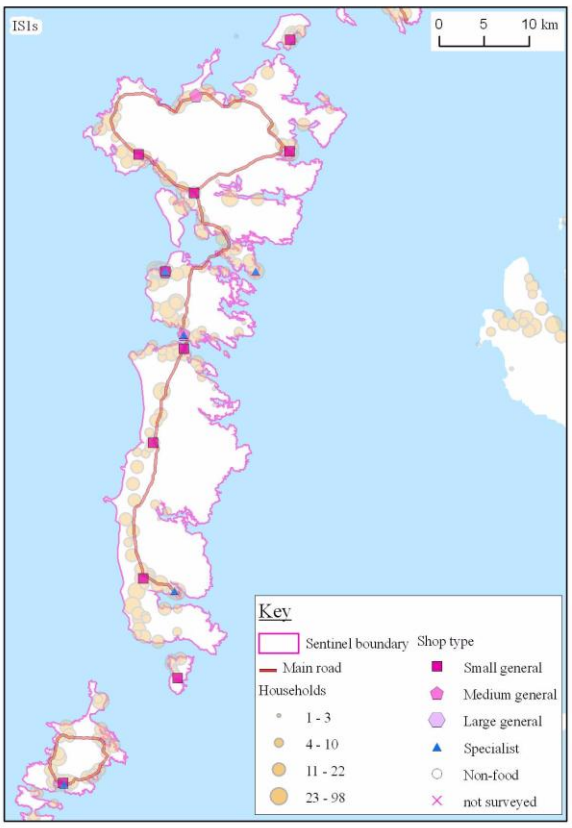
The following 4 maps show the location of food stores and main areas of population in four selected sentinels






Population and Food Retail Location in RA1
Scale 1:150,000
0 1 2 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
Shop type
Small general
Medium general
Large general
Specialist
Non-food
not surveyed


Population and Food Retail Location in IS1
Scale 1:450,000
IS1n


IS1s
0 5 10 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
Shop type
Small general
Medium general
Large general
Specialist
Non-food
not surveyed

3.1.5. Types of food store by population density

It can be seen from Table 18 that there are more people per small general store and specialist store in urban areas.

Table 18: Types of food store by population density

Sentinel ID	UR2	UR1	UR3	ST1	ST2	RD1	RA1	IS2	IS1
Sentinel environment	Urban D	Urban A	Urban M	Small Town D	Small Town A	Rural D	Rural A	Island M	Island M/D
SEUR order	1	2	3	4	5	7	6	8	9
Population	79,368	32,734	44,218	21,763	17,260	7,988	35,582	19,245	26,502
Popn per sq km	4,091	2,242	972	2,531	2,431	4	64	19	9
Population per store of type:									
large general	19,842	32,734	8,844	21,763	n/a	n/a	35,582	n/a	26,502
medium general	9,921	8,184	14,739	7,254	4,315	n/a	35,582	9,623	6,626
small general	1,005	2,338	1,078	1,360	1,726	533	1,369	687	680
specialist	4,409	2,046	2,327	1,814	1,726	1,997	1,047	1,604	1,656
food secondary	13,228	8,184	22,109	n/a	n/a	7,988	17,791	n/a	n/a

3.1.6. Types of food store by deprivation (SIMD)

The distribution of food stores in the survey compared to area deprivation using the 2006 Scottish Index of Multiple Deprivation (SIMD 2006) was considered. Each store in the survey was assigned the deprivation score of the data zone in which it was located and the data were aggregated to the data zone level and data were pooled across all nine sentinel sites. This gave us 466 stores located in 199 data zones in our survey areas. Data zones were then divided into quintiles of deprivation and the distribution of stores by quintile is shown in Table 19.

Table 19: Distribution of food stores by area deprivation

	Deprivation				
General Food Store	1 (affluent) *% (n)*	2 *% (n)*	3 *% (n)*	4 *% (n)*	5(deprived) *% (n)*
- large	15.4 (2)	30.8 (4)	15.4 (2)	15.4 (2)	23.1 (3)
- medium	17.2 (5)	3.5 (1)	41.4 (12)	6.9 (2)	31.0 (9)
- small	13.8 (37)	19.4 (52)	19.8 (53)	21.3 (57)	25.8 (69)
Specialist	16.3 (23)	22.0 (31)	38.3 (54)	3.6 (5)	19.9 (28)
Food secondary	13.3 (2)	26.7 (4)	13.3 (2)	26.7 (4)	20.0 (3)
Total	14.8 (69)	19.7 (92)	26.4 (123)	15.0 (70)	24.0 (112)

There is no clear pattern in the total distribution of food stores across the sentinel sites. This inconsistent pattern of distribution remains for medium general food, specialist and primarily food secondary retail outlets. However for large general food stores there is a relatively even pattern across quintiles and for small general food stores there is a linear increase in the number of outlets as quintile of deprivation increases. In general the more deprived data zones in our sentinel sites have the greater number of food retail shops located within them, with many of these being small general food stores.

The relationship between population distribution, area deprivation and number of stores across the sentinel sites was explored.

Figure 4 and Figure 5 show scatter plots of all food stores and general food stores per 1000 population for each data zone by area deprivation.

Figure 4 shows that for all stores there is very weak positive correlation between stores per 1000 population and deprivation (r=0.0761; p=0.286; 95% CI, 0.127 to 0.043).

Figure 5 shows that when we consider general stores only there is a weak, though borderline statistically significant, positive correlation between number of general food stores per 1000 population and deprivation (r=0.1925; p=0.006; 95% CI, 0.005 to 0.031).

Both these figures suggest that as deprivation increase the number of stores per 1000 population in each data zone also increases, though it must be emphasised that this association is only weakly positive.

We also decomposed the general stores into large, medium and small stores (graphs not shown). Large and small general stores followed the pattern for all general stores – an increasing number of stores per 1000 population as deprivation increases. However for large general stores this was not statistically significant and very weakly correlated (r=0.046, p=0.888, 95% CI = -0.019 to 0.021). For small general stores the correlation was stronger and statistically significant (r=0.22, p=0.002, 95% CI = 0.005 to 0.020). For medium general stores there was a negative correlation with fewer medium sized stores per 1000 population as area deprivation increased, though this was weakly correlated and not statistically significant (r=-0.09, p=0.676, 95% CI= -0.012 to 0 .007). The size of the samples for large and medium sized stores was small and thus findings should be interpreted with considerable caution.

Figure 4: Correlation between all food stores per 1000 pop and area deprivation

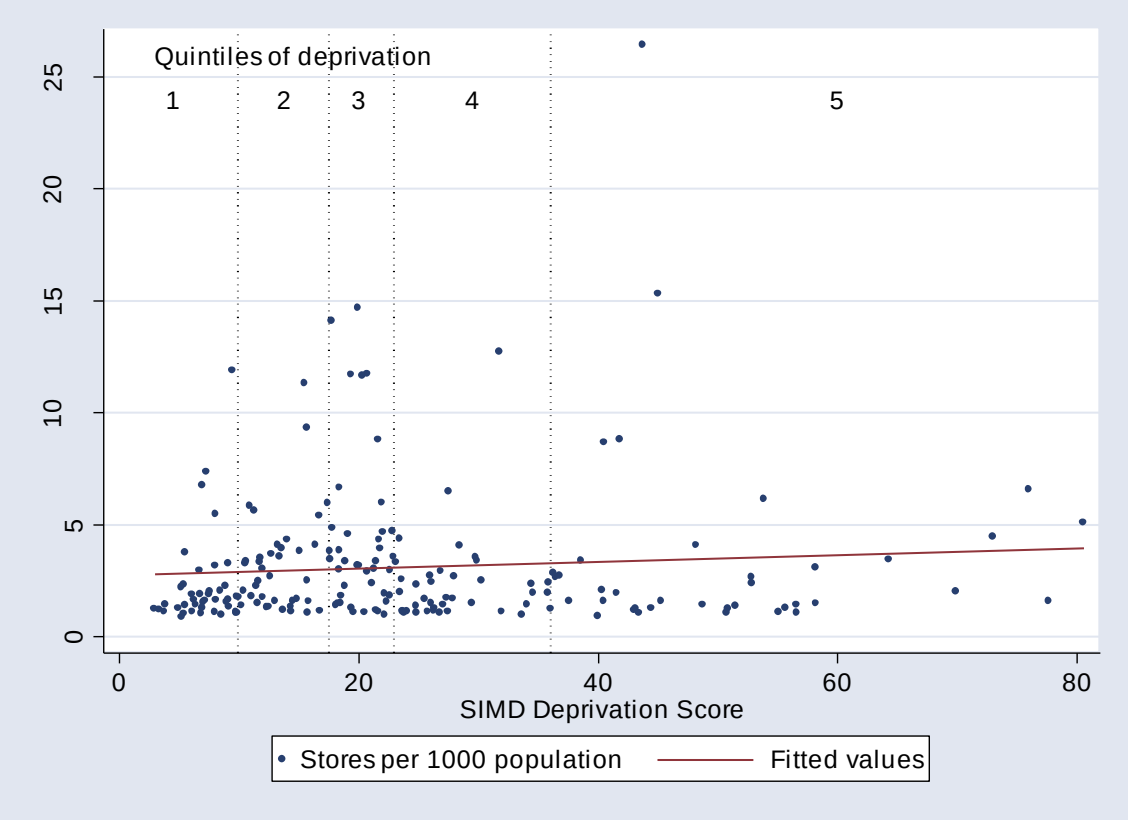
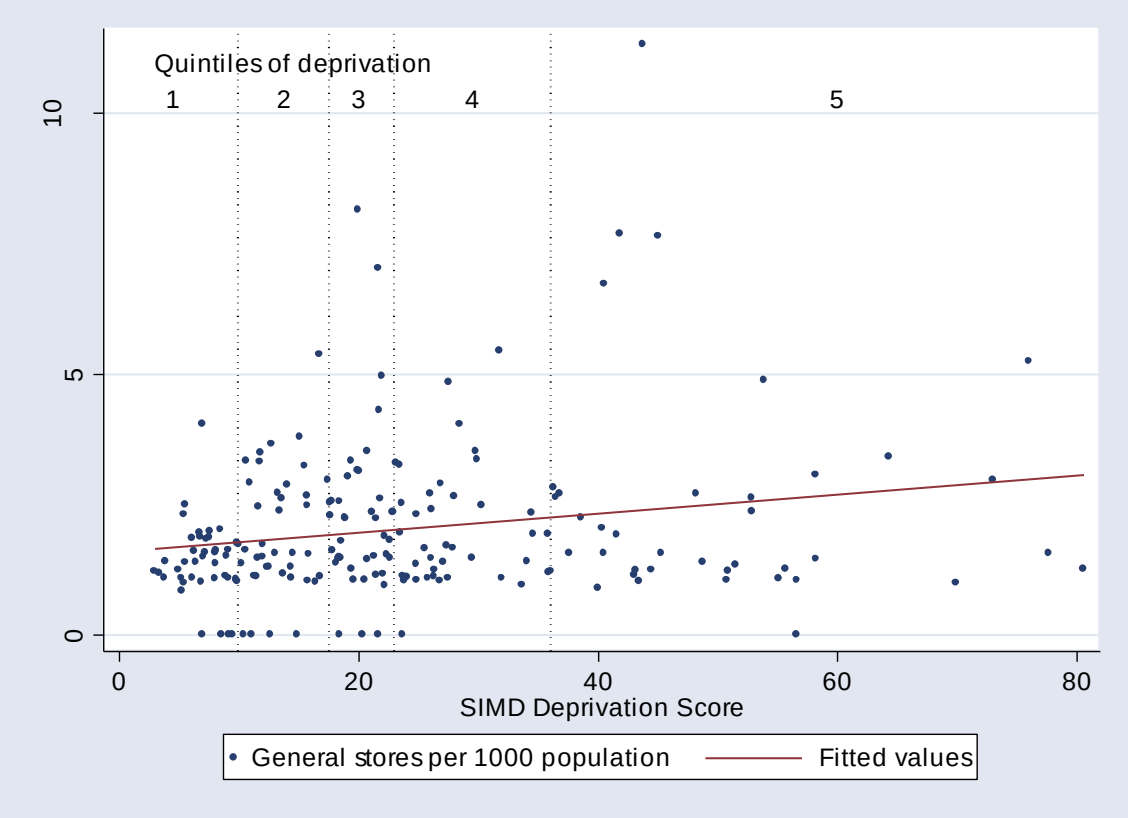


Figure 5: Correlation between general food stores per 1000 pop and area deprivation



3.2. HEISB availability variation

3.2.1. Key points

- Only large, and some medium, sized general stores stocked the entire HEISB
- Semi-skimmed milk was the most widely stocked healthy food; brown rice and frozen berries were the least widely stocked.
- There was wide variation in availability. The HEISB acts as a satisfactory general tool to discriminate amongst the range of choices available for healthy foods.
- The HEISB discriminated well between different individual stores within the small general, specialist and food secondary store types.
- Large stores were least likely to stock the fish protein items with the total HEISB.
- Baked beans and semi-skimmed milk were most likely to be stocked across all types of general food store.
- There is some evidence that some basic products, in particular meat and fish items, are less available in more deprived areas but there is no consistent pattern.
- The fruit and carbohydrate groups were generally more available than the vegetable group.
- Availability patterns by individual components of deprivation are varied. There is some evidence to suggest that there tends to be particularly poorer availability of some items for income, employment, health and crime deprivation.

3.2.2. Availability of all food items

Across the nine sentinel sites and 466 shops included in this survey only fifteen (3.2%) stocked all thirty-five items in HEISB. Of these, eleven were large general stores and four were medium general stores. On this basis 85% of large general stores and 14% of medium general stores stocked all thirty-five items. This distribution of stores selling all thirty-five items did not vary significantly by sentinel site ($p=0.638$) or by deprivation ($p=0.526$).

Table 20 shows the most common food items stocked in stores in the survey. Semi-skimmed milk is the most ubiquitous food item, found in 75.3% of stores. The next most common items were baked beans, orange juice, spaghetti and oats. The least common items were haddock fillets, sweetcorn, salmon fillets, brown rice and lastly frozen berries which were found in 14.4% of stores.

The lowest number of food items stocked was 1 ($n=26$). Typically these were specialist stores, e.g. fishmongers or delicatessens. If a store stocked no items then it was deemed to not be a food store and was not included in the survey.

Table 20: Most common food items

Rank	Food items	Frequency	%	Rank	Food items	Frequency	%
1	Semi-skimmed milk	351	75.3	19	Frozen peas	220	47.2
2	Baked beans	333	71.5	20	Brown rolls	205	44.0
3	Orange juice	305	65.5	21	Cucumber	169	36.3
4	Spaghetti	297	63.7	22	Low fat spread	164	35.2
5	Oats	284	60.9	23	Round lettuce	163	35.0
6	Weetabix	282	60.5	24	Birds eye lasagne	162	34.8
7	Wholemeal bread	276	59.2	25	White grapes	157	33.7
8	Onions	275	59.0	26	Broccoli	152	32.6
9	Pineapple	270	57.9	27	Red pepper	151	32.4
10	White rice	264	56.7	28	Chicken breasts	147	31.6
11	Potatoes	263	56.4	29	Lean beef mince	145	31.1
12	Apples	247	53.0	30	Skimmed milk	142	30.5
13	Tomatoes	244	52.4	31	Haddock fillets	115	24.7
14	Bananas	243	52.2	32	Sweetcorn	92	19.7
15	Carrots	238	51.1	33	Salmon fillets	71	15.2
16	Low fat yoghurt	233	50.0	34	Brown rice	67	14.4
17	Oven chips	232	49.8	35	Frozen berries	67	14.4
18	Oranges	230	49.4				

3.2.3. Availability by food group

Table 21 shows the mean and median percentage of HEISB items stocked for each food group across all shops as well as the minimum, maximum, standard deviation and inter-quartile range. As expected from this summary table there is a wide variation in the percentage of items stocked across all the shops in the survey with stocks ranging from 0 to 100%. Overall the median percentage of items stocked for the whole basket was 42.9% with the highest median percentage of items stocked for carbohydrates (55.6%).

Table 21: Summary percentage of HEISB items stocked in all stores by food group

Food Group	n	Mean	SD	Minimum	Maximum	Median	IQ range
HEISB	466	44.5	31.6	2.9	100.0	42.9	11.4 - 74.3
Fruit	466	46.6	36.1	0.0	100.0	42.9	14.3 - 85.7
Vegetables	466	43.7	37.0	0.0	100.0	40.0	10.0 - 80.0
Carbohydrates	466	51.7	34.4	0.0	100.0	55.6	22.2 - 77.8
Protein	466	25.6	33.7	0.0	100.0	0.0	0.0 - 50.0
Ready-meal	466	34.8	47.7	0.0	100.0	0.0	0.0 - 100.0
Dairy	466	47.7	35.7	0.0	100.0	50.0	25.0 - 75.0

3.2.4. Availability by shop type

The distribution of HEISB stocked, by shop type is non-normal. We can therefore more usefully explore availability by using the median as an indicator of the distribution centre. Table 22 shows the wide variation in availability by type of food store. For all items in HEISB we can see high availability for large and medium general stores and low availability, as would be expected, within specialist and stores where food is secondary. As some products were specifically chosen for the HEISB (as they would be less widely stocked) this variability must be seen as a function of the design of the HEISB as well as the stocking policy of retailers.

Table 22: Median percentage of HEISB items stocked by food group and by shop type

Food group	Large general	Medium general	Small general	Specialist	Food secondary
HEISB	100.0	91.4	50.0	8.6	25.7
Fruit	100.0	85.7	71.4	0.0	14.3
Vegetables	100.0	100.0	50.0	0.0	10.0
Carbohydrates	100.0	100.0	66.7	11.1	33.3
Protein	100.0	100.0	0.0	0.0	0.0
Ready-meal	100.0	100.0	0.0	0.0	0.0
Dairy	100.0	100.0	50.0	0.0	25.0

Considering availability by food group we can see that large general stores stock a median of 100% of items across all categories. Medium general stores have the same high level of availability with the exception of fruit items. It would appear that the HEISB was not particularly discriminating between medium, and especially large, general stores.

There is wide variation within the specialist store type. As would be expected the different specialists score highly on particular food groups. Similarly for small general stores though median availability for some food groups is zero, some stores within this type do sell 100% of items within food groups.

Table 23 shows the proportion of stores in which each individual food item was available by shop type. As expected there are significant differences in the proportion in which each item is available across all food items in all shop categories. This significant relationship remains when comparing general stores only, with the exception of baked beans and semi-skimmed milk. Large general stores have 100% availability of every food item in HEISB except two protein items, salmon and haddock fillets. Medium general stores also have good availability particularly for fruit (52%-100%) and vegetables (69%-100%), small general stores are a good deal more variable for the range of items in these two categories.

Table 23: Proportion of stores in which food items are available by shop type

Shaded areas indicated statistically significant differences at p=0.05 or less

Food items	Large general	Medium general	Small general	Specialist	Food secondary	Chi squared	p value
Shops (n)	13	29	268	141	15		
FRUIT							
Frozen berries	100.0	51.7	11.6	5.7	0.0	123.19	<0.001
White grapes	100.0	93.1	34.7	16.3	6.7	95.50	<0.001
Bananas	100.0	100.0	62.3	21.3	26.7	107.39	<0.001
Apples	100.0	100.0	63.4	23.4	13.3	108.01	<0.001
Oranges	100.0	89.7	58.6	23.4	6.7	90.23	<0.001
Pineapple	100.0	86.2	77.6	12.8	40.0	181.56	<0.001
Orange juice	100.0	96.6	86.2	16.3	33.3	220.83	<0.001
VEGETABLES							
Sweetcorn	100.0	69.0	21.6	0.7	0.0	133.73	<0.001
Broccoli	100.0	93.1	29.9	22.7	0.0	89.64	<0.001
Red pepper	100.0	82.8	32.1	19.2	6.7	76.55	<0.001
Cucumber	100.0	93.1	38.8	17.7	0.0	93.62	<0.001
Round lettuce	100.0	82.8	38.4	16.3	0.0	84.35	<0.001
Tomatoes	100.0	100.0	60.1	27.7	13.3	88.25	<0.001
Frozen peas	100.0	100.0	60.5	9.9	13.3	151.35	<0.001
Carrots	100.0	96.6	58.2	28.4	6.7	82.84	<0.001
Onions	100.0	100.0	69.0	31.2	26.7	91.85	<0.001
Baked beans	100.0	100.0	93.3	22.7	60.0	244.73	<0.001
CARBOHYDRATES							
Brown rice	100.0	55.2	9.3	9.2	0.0	127.74	<0.001
Brown rolls	100.0	96.6	41.0	36.9	13.3	58.63	<0.001
Wholemeal bread	100.0	100.0	66.4	36.9	26.7	70.40	<0.001
Potatoes	100.0	96.6	65.7	29.8	26.7	84.45	<0.001
Oven chips	100.0	96.6	65.7	8.5	20.0	166.95	<0.001
White rice	100.0	100.0	71.6	17.7	33.3	146.96	<0.001
Spaghetti	100.0	96.6	82.8	19.2	46.7	186.37	<0.001
Oats	100.0	89.7	79.1	19.2	40.0	161.75	<0.001
Weetabix	100.0	93.1	84.0	6.4	53.3	256.24	<0.001
MEALS							
Birds eye lasagne	100.0	72.4	44.8	4.3	13.3	115.27	<0.001
PROTEIN							
Salmon fillets	92.3	72.4	6.7	14.2	0.0	151.08	<0.001
Chicken breasts	100.0	96.6	27.2	23.4	0.0	98.50	<0.001
Lean beef mince	100.0	89.7	26.1	25.5	0.0	87.10	<0.001
Haddock fillets	84.6	79.3	20.9	17.7	0.0	82.33	<0.001
DAIRY							
Skimmed milk	100.0	93.1	32.8	8.5	13.3	118.24	<0.001
Low fat spread	100.0	93.1	42.9	5.0	13.3	133.21	<0.001
Low fat yoghurt	100.0	96.6	64.2	11.4	26.7	147.22	<0.001
Semi-skimmed milk	100.0	96.6	94.8	31.2	80.0	213.67	<0.001

3.2.5. Availability by sentinel

Table 24 shows the proportion of stores in which each individual food item was available by the nine sentinel sites. There were significant differences in availability by site for thirty-two of the thirty-five items in the HEISB. Only wholemeal bread, salmon and low fat spread did not differ significantly in availability.

3.2.6. Availability and deprivation (SIMD)

Table 25 shows the proportion of stores in which each individual food item is available by quintile of deprivation. Eighteen of the thirty-five food items significantly differed in availability by sentinel site. Of these eighteen foods, ten items had a statistically significant test for trend: orange juice, White grapes, broccoli, cucumber, red pepper, carrots, brown rolls, lean beef mince, chicken breasts and skimmed milk. Of the eighteen significant associations with deprivation: oranges, bananas, broccoli, red pepper, carrots, brown rolls, chicken breasts and skimmed milk were the least available in data zones that fall into the most deprived quintile of deprivation. Though these items are less available in the most deprived quintile, there is no consistent pattern across deprivation categories. In some cases (for example chicken breasts and red peppers) the greatest availability was in quintile three.

Table 24: Proportion of stores in which food items are available by sentinel site

Sentinel ID	UR2	UR1	UR3	ST1	ST2c	ST2e	RD1	RA1	IS2	IS1		
Sentinel environment	Urban D	Urban A	Urban M	Small Town D	Small Town A	Small Town A	Rural D	Rural A	Island M	Island M/D	Chi Squared	p value
Shops (n)	115	39	70	32	15	9	20	64	42	60		
FRUIT												
Apples	43.5	45.6	51.4	50.0	40.0	66.7	80.0	48.4	90.0	70.0	44.31	<0.001
Bananas	47.0	25.6	51.4	43.8	10.0	55.6	80.0	43.8	76.2	70.0	39.49	<0.001
White grapes	26.1	15.4	30.0	25.0	26.7	44.4	70.0	31.3	66.7	36.7	43.79	<0.001
Oranges	37.4	18.0	47.1	37.5	40.0	55.6	80.0	50.0	81.0	70.0	59.11	<0.001
Pineapple	59.1	38.5	62.9	59.4	40.0	44.4	80.0	35.9	81.0	68.3	38.01	<0.001
Orange juice	76.5	51.3	64.3	53.1	33.3	55.6	75.0	53.1	73.8	75.0	27.94	0.001
Frozen berries	9.6	15.4	14.3	6.3	13.3	11.1	25.0	7.8	16.7	30.0	20.15	0.017
VEGETABLES												
Broccoli	15.7	15.4	24.3	28.1	33.3	44.4	70.0	37.5	69.1	43.3	65.32	<0.001
Red pepper	18.3	12.8	27.1	25.0	33.3	33.3	70.0	34.4	64.3	45.0	55.88	<0.001
Carrots	36.5	28.2	45.7	50.0	40.0	55.6	85.0	51.6	78.6	71.7	51.64	<0.001
Round lettuce	23.5	18.0	30.0	31.3	33.3	44.4	65.0	37.5	66.7	40.0	40.30	<0.001
Cucumber	27.8	15.4	28.6	34.4	40.0	44.4	65.0	37.5	69.1	40.0	40.17	<0.001
Baked beans	79.1	61.5	74.3	68.8	40.0	55.6	85.0	50.0	85.7	80.0	36.56	<0.001
Onions	55.6	33.3	52.9	56.3	40.0	55.6	85.0	56.3	83.3	73.3	35.80	<0.001
Frozen peas	41.7	38.5	41.4	46.9	33.3	44.4	80.0	32.8	76.2	58.3	35.79	<0.001
Sweetcorn	15.7	12.8	12.9	21.9	20.0	22.2	10.0	20.3	50.0	20.0	30.10	<0.001
Tomatoes	47.0	35.9	45.7	56.3	40.0	44.4	80.0	50.0	78.6	58.3	26.86	0.001
CARBOHYDRATES												
Potatoes	60.0	25.6	50.0	37.5	40.0	55.6	85.0	45.3	85.7	73.3	54.61	<0.001
White rice	55.7	30.8	54.3	53.1	46.7	44.4	75.0	45.3	85.7	70.0	37.05	<0.001
Oven chips	50.4	28.2	47.1	50.0	40.0	44.4	80.0	31.3	73.8	61.7	37.34	<0.001
Brown rolls	27.0	33.3	52.9	40.6	46.7	77.8	70.0	45.3	73.8	38.3	43.41	<0.001
Spaghetti	67.0	51.3	64.3	62.5	46.7	44.4	75.0	46.9	83.3	73.3	24.84	0.003
Weetabix	66.1	48.7	64.3	59.4	46.7	55.6	65.0	40.6	81.0	63.3	23.80	0.005
Oats	60.0	53.9	58.6	62.5	40.0	44.4	75.0	48.4	81.0	71.7	20.69	0.014
Brown rice	7.0	7.7	11.4	18.8	20.0	22.2	15.0	12.5	28.6	23.3	19.36	0.022
Wholemeal bread	59.1	53.9	61.4	53.1	53.3	77.8	75.0	50.0	76.2	55.0	12.37	0.193

D=deprived; M=mixed; A=affluent; Shaded areas indicated statistically significant differences at p=0.05 or less

Table 24 continued: Proportion of stores in which food items are available by sentinel site

Sentinel ID	UR2	UR1	UR3	ST1	ST2c	ST2e	RD1	RA1	IS2	IS1		
Sentinel environment	Urban D	Urban A	Urban M	Small Town D	Small Town A	Small Town A	Rural D	Rural A	Island M	Island M/D	Chi Squared	p value
Shops (n)	115	39	70	32	15	9	20	64	42	60		
MEALS												
Birds eye lasagne	36.5	15.4	37.1	25.0	26.7	44.4	40.0	25.0	47.6	46.7	18.68	0.028
PROTEIN												
Haddock fillets	12.2	25.6	12.9	12.5	33.3	44.4	30.0	10.9	50.0	58.3	77.86	<0.001
Lean beef mince	19.1	25.6	34.3	25.0	20.0	44.4	55.0	21.9	59.5	40.0	36.65	<0.001
Chicken breasts	21.7	25.6	28.6	25.0	33.3	44.4	65.0	23.4	52.4	41.7	30.99	<0.001
Salmon fillets	10.4	23.1	15.7	12.5	26.7	33.3	15.0	10.9	21.4	15.0	10.07	0.345
DAIRY												
Skimmed milk	20.0	30.8	25.7	25.0	33.3	44.4	70.0	25.0	54.8	31.7	35.43	<0.001
Low fat yoghurt	47.8	30.8	55.7	37.5	26.7	55.6	70.0	45.3	73.8	53.3	25.83	0.002
Semi-skimmed milk	80.9	76.9	77.1	81.3	40.0	88.9	80.0	59.4	83.3	75.0	24.09	0.004
Low fat spread	39.1	33.3	27.1	25.0	33.3	44.4	60.0	25.0	47.6	36.7	15.86	0.070

D=deprived; M=mixed; A=affluent; Shaded areas indicated statistically significant differences at p=0.05 or less

Table 25: Proportion of stores in which food items are available by quintile of deprivation

	1	2	3	4	5	Chi squared	p value
	affluent				deprived		
N (shops)	69	92	123	70	112		
FRUIT							
Orange juice	60.9	59.8	57.7	87.1	67.9	20.05	<0.001
Oranges	47.8	55.4	51.2	62.9	34.8	16.17	0.003
Pineapple	53.6	50.0	57.7	78.6	54.5	15.69	0.003
Bananas	44.9	54.4	53.7	68.6	42.9	13.17	0.010
Apples	53.6	55.4	52.9	65.7	42.9	9.40	0.052
White grapes	37.7	39.1	37.4	27.1	26.8	6.20	0.185
Frozen berries	11.6	17.4	17.9	12.9	10.7	3.70	0.449
VEGETABLES							
Broccoli	34.8	41.3	42.3	27.1	17.0	21.97	<0.001
baked beans	71.0	64.1	65.0	90.0	73.2	16.88	0.002
Red pepper	30.4	39.1	39.8	35.7	17.9	16.30	0.003
Carrots	55.1	51.1	57.7	60.0	35.7	15.42	0.004
Onions	56.5	59.8	61.0	71.4	50.0	8.62	0.071
Sweetcorn	18.8	29.4	20.3	15.7	14.3	8.24	0.083
Round lettuce	33.3	44.6	37.4	34.3	25.9	8.20	0.085
Cucumber	43.5	41.3	39.0	31.4	27.7	7.25	0.123
Frozen peas	44.9	48.9	49.6	57.1	38.4	6.80	0.147
Tomatoes	55.1	54.4	53.7	60.0	42.9	6.13	0.190
CARBOHYDRATES							
Brown rolls	49.3	57.6	48.0	37.1	29.5	19.42	0.001
Weetabix	60.9	55.4	53.7	82.9	58.0	18.33	0.001
Spaghetti	58.0	60.9	61.0	81.4	61.6	11.42	0.022
White rice	46.4	59.8	55.3	71.4	52.7	10.37	0.035
Oven chips	42.0	46.7	52.9	64.3	44.6	9.53	0.049
Oats	56.5	57.6	60.2	77.1	57.1	9.43	0.051
Potatoes	47.8	54.4	60.2	68.6	51.8	8.12	0.087
Brown rice	13.0	20.7	17.1	11.4	8.9	6.96	0.138
Wholemeal bread	58.0	67.4	61.8	51.4	55.4	5.38	0.251
MEALS							
Birds eye lasagne	31.9	33.7	32.5	47.1	32.1	5.64	0.228
PROTEIN							
Lean beef mince	31.9	42.4	36.6	20.0	22.3	15.27	0.004
Chicken breasts	30.4	37.0	40.7	24.3	22.3	12.13	0.016
Haddock fillets	21.7	27.2	33.3	25.7	14.3	12.13	0.016
Salmon fillets	18.8	14.1	20.3	8.6	12.5	6.30	0.178
DAIRY							
Skimmed milk	37.7	33.7	36.6	27.1	18.8	11.94	0.018
Semi-skimmed milk	72.5	77.2	67.5	88.6	75.9	11.17	0.025
Low fat yoghurt	49.3	54.4	46.3	57.1	46.4	3.37	0.498
Low fat spread	36.2	31.5	36.6	37.1	34.8	0.80	0.938

Shaded areas indicated statistically significant differences at p=0.05 or less

3.2.7. Availability and deprivation by components of SIMD

The global measure of deprivation used in this analysis (SIMD 2006) is derived from seven individual components which reflect the multi-dimensional nature of deprivation. These components include income, employment, health, education training and skills, housing, geographic access and crime. The availability of individual food items was also analysed for each of the components of deprivation (for tables see Appendix 12: Supplementary analysis).

Appendix Table 14 shows the availability of food items by quintiles of income deprivation. There was evidence of an association between income and availability in fourteen of the food items, and all of these had a statistically significant test for trend. Oranges, broccoli, red peppers, carrots, sweetcorn, brown rolls, brown rice, lean beef mince, haddock fillets, chicken breasts and skimmed milk were least available in the most income-deprived quintile (quintile 5) and white grapes, cucumber and round lettuce in quintile 4. This suggests a trend of lower availability in quintiles of higher income deprivation.

Employment deprivation was associated with the availability of nineteen food items (Appendix Table 15), of which fourteen had a statistically significant test for trend (74%). Oranges, apples, bananas, broccoli, carrots, red peppers, onions, round lettuce, tomatoes, frozen peas, brown rolls and haddock fillets were least available in the quintile with highest employment deprivation (quintile 5), frozen berries, white grapes, cucumber, brown rice, lean beef mince, chicken breasts and skimmed milk in quintile 4 and oven chips in quintile 2. This highlights the trend of decreasing availability of food items as employment deprivation increases.

Appendix Table 16 shows the proportion of stores in which food items are available by quintile of health deprivation, revealing evidence of association between this component and availability in twenty-five food items. Oranges, bananas, white grapes, carrots, red peppers, broccoli, tomatoes, onions, round lettuce, cucumber, brown rolls and skimmed milk were least available in the quintile with the greatest health deprivation (quintile 5), apples, pineapple, orange juice, frozen peas, baked beans, oven chips, oats, weetabix, potatoes, spaghetti, White rice, and low fat yoghurt in quintile 3 and salmon fillets in quintile 2. Items tended to be less available in areas with greater health deprivation, but the pattern was less apparent with only 13 demonstrating statistical evidence of a trend (52%).

There was little evidence of an association between education, skills and training deprivation and availability of food items, with only ten items showing evidence of differences in availability (Appendix Table 17). Orange juice, pineapple, baked beans, weetabix and semi-skimmed milk were least available in the most educated quintile, and broccoli, red peppers, brown rolls, brown rice and haddock fillets in the least educated quintile. Although all these items also had a statistically significant test for trend, there was no obvious pattern to the direction of the association.

Appendix Table 18 shows the availability of food items by quintile of housing deprivation, which demonstrates little evidence of an association with eleven food items demonstrating statistically significant differences, of which six had a statistically significant test for trend (55%). Carrots, broccoli, red peppers, brown rolls, lean beef mince, chicken breasts, haddock fillets and skimmed milk were least available in the most housing-deprived quintile (quintile 5), and baked beans, wholemeal bread and weetabix in quintile 2.

There was very strong evidence of an association between geographic access deprivation and availability of food items, with thirty-one items having a statistically significant association of

which thirty showed evidence of a trend (97%) (Appendix Table 19). All of these were least available in the quintile with best geographic access (quintile 1) except white grapes in quintile 2 and frozen berries, brown rice, haddock fillets and lean beef mince in quintile 3. There was very strong evidence of a trend, with items being least available in areas with good access and most available in areas with poor access. This may seem strange at a superficial level but the nature of the measure of geographic access used in SIMD accounts for this. Urban areas have higher access than rural areas. It is then accounted for by the nature of retail range provision in the smaller stores in rural and urban areas. Individual stores in the rural areas are more likely to have a wider range of items because of the absence of other nearby stores. They have an element of spatial monopoly in their operation (this also affects price setting as seen later in this report). In the individual urban small stores with higher access there is a stronger tendency to limit ranges due to the intensity of competition with other stores that are similarly easily accessed.

Appendix Table 20 shows the proportion of stores in which food items are available by quintiles of crime, and reveals an association between crime and availability in eighteen items, of which all show evidence of a trend. Oranges, apples, pineapple, carrots, onions, tomatoes, broccoli, frozen peas, red pepper, potatoes, oats, spaghetti, White rice, and oven chips were least available in the quintile with highest crime (quintile 5), haddock fillets, lean beef mince and skimmed milk in quintile 4 and bananas and white grapes in quintile 3. Therefore there was convincing evidence of a trend of poor availability of food items in areas of high crime levels and greater availability in areas with low levels of crime.

3.2.8. Relative availability of food groups

In order to explore availability in a more meaningful way we have followed White *et al* (2004) and constructed indices of relative availability for each food group by generating ratios of availability for each of the six food categories to total HEISB. A ratio of more than one indicates better availability of that group compared to HEISB as a whole (group over-represented) while a ratio of less than one indicates better availability of HEISB as a whole compared to that food group (group under-represented). Using this we get a sense of the 'balance' of availability of items in the HEISB. Ratios are shown in Table 26 split by sentinel site, in Table 27 by shop type and in Table 28 by deprivation.

Table 26: Ratio of availability of each food group compared to HEISB by sentinel site

Sentinel ID	UR2	UR1	UR3	ST1	ST2c	ST2e	RD1	RA1	IS2	IS1
Sentinel Environment	Urban D	Urban A	Urban M	Small town D	Small town A	Small town A	Rural D	Rural A	Island M	Island M/D
SEUR order	1	2	3	4	5	5	7	6	8	9
HEISB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fruit	0.77	1.25	1.25	1.00	0.83	1.67	1.07	0.83	1.09	1.35
Vegetables	0.81	0.44	0.55	1.26	0.58	0.78	1.06	0.87	1.15	0.95
Carbohydrates	1.50	1.45	1.22	1.40	0.65	1.30	1.11	0.97	1.13	1.36
Protein	0.00	0.00	0.00	0.00	0.73	1.95	0.63	0.00	0.64	0.47
Meal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dairy	1.35	1.09	1.09	0.70	0.00	1.95	1.25	0.73	0.95	0.95

D=deprived; M=mixed; A=affluent.

Table 26 shows that fruit had better relative availability than all items in HEISB in seven of the nine sentinel sites. Sites where fruit was under-represented were rural affluent, small town affluent and urban deprived settings. Vegetables had the worst relative availability with poorer relative

availability in seven of the ten settings including all urban areas, small town affluent, island mixed/deprived and rural affluent. Carbohydrates had the best overall relative availability with greater availability in eight of the ten settings – only rural and small town affluent locations had worse relative availability for this group. Dairy products tended to be better represented in urban compared to rural and island settings. The contrast between fruit and carbohydrates (well represented) and vegetables (poorly represented) is apparent.

When considering availability by store type (Table 27) it can be seen that large general stores had full availability of all food categories. The other general store categories tended to have better availability of some categories of food than others. Small general stores had better relative availability of fruit and carbohydrates and medium general stores were better for all items except for fruit. Again the contrast between well represented fruit and carbohydrates and less well represented other groups is seen in these smaller shops.

Table 27: Ratio of availability of each food group compared to HEISB by shop type

Food Group	Large general	Medium general	Small general	Specialist	Food Secondary
HEISB	1.00	1.00	1.00	1.00	1.00
Fruit	1.00	0.94	1.43	0.00	0.56
Vegetables	1.00	1.09	1.00	0.00	0.39
Carbohydrates	1.00	1.09	1.33	1.29	1.30
Protein	1.00	1.09	0.00	0.00	0.00
Meal	1.00	1.09	0.00	0.00	0.00
Dairy	1.00	1.09	1.00	0.00	0.97

By deprivation (Table 28) we can see that the relative availability of vegetables gets worse as deprivation increases whereas fruit tends to be relatively more available in the poorest quintile. In terms of the balance of the HEISB the most deprived data zones have greater relative availability of fruit, carbohydrates and dairy whereas the most affluent quintile does better for all food categories except protein and dairy.

Table 28: Ratio of availability of each food group compared to HEISB by deprivation quintile

Food Group	1 (affluent)	2	3	4	5 (deprived)
HEISB	1.00	1.00	1.00	1.00	1.00
Fruit	1.07	1.33	1.00	1.39	1.71
Vegetables	1.00	1.17	0.93	0.97	0.58
Carbohydrates	1.11	1.56	1.56	1.30	1.62
Protein	0.00	0.00	0.58	0.00	0.00
Meal	0.00	0.00	0.00	0.00	0.00
Dairy	1.25	1.17	1.17	0.97	1.46

Overall the total number of foods available (out of 35) per shop was weakly negatively correlated with deprivation, as deprivation increases the number of foods available fell, but this was of borderline statistical significance (Pearson $r = -0.09$, $p = 0.052$). All individual food categories were also negatively correlated with deprivation; fruit ($r = -0.055$, $p = 0.232$); vegetables ($r = -0.121$, $p = 0.009$); carbohydrates ($r = -0.045$, $p = 0.332$); meals ($r = -0.012$, $p = 0.796$); protein ($r = -0.128$, $p = 0.017$) and dairy ($r = -0.062$, $p = 0.183$) but only protein and vegetables significantly. The issue with access to vegetables again is apparent.

Table 29 shows the results of a paired analysis for availability by environmental setting. In each environmental setting (island, rural, small town and urban) the affluent sentinel site and its deprived analogue are compared. For island settings overall availability was good for the majority of items in the basket. Thirty-one of the thirty-five items were less available in the mixed/deprived island location than in its more affluent counterpart, though only in ten items were the proportions significantly different (white grapes, broccoli, round lettuce, tomatoes, cucumber, sweetcorn, brown rolls, wholemeal bread, skimmed milk and low fat yoghurt).

In rural settings the converse was true with all items being less available in the more affluent analogue. This difference in proportions was statistically significant for all but nine items (orange juice, sweetcorn, weetabix, brown rice, brown rolls, lasagne, salmon fillets, semi-skimmed milk and low-fat yoghurt). However a lot more market stalls selling only 1 or 2 items were surveyed in the affluent rural sentinel than in the other sentinels which may have produced this result.

Small town settings are much more equitable, though differences do exist between deprived and affluent locations for individual food items. In most cases these were not particularly large and were not statistically significant.

In urban settings we had a continuum of deprivation; affluent, mixed and deprived. There were differences in availability between these three locations for ten items (apples, bananas, oranges, orange juice, pineapple, potatoes, White rice, brown rolls, lasagne and low fat yoghurt). Testing for trend, eight items had a p-value of less than 0.05 (apples, bananas, oranges, frozen peas, spaghetti, White rice, lasagne, and low fat yoghurt).

3.2.9. Conclusions

The conclusions to be drawn from the data on access to food items in the HEISB are:

- The HEISB is a useful tool to discriminate access to healthy foods in different areas
- Whilst overall the level of access could be deemed to be good there are significant difference in levels of access to particular food groups
- The differences in access reflect strongly the nature of the retail structure of an area with the presence of a large store resulting in a high level of availability of all items in the HEISB
- If the large store factor is removed then it appears that (comparing Table with Table) some food groups are less available in areas of high deprivation as measured on an overall measure of deprivation. Whilst fruit and carbohydrates have relatively good access this is not the case for vegetables.
- If the measure of deprivation is disaggregated and access to HEISB is considered in areas high income deprivation then in addition to lower access to vegetables there is also lower level of access to basic fruit such as oranges and to some proteins, for example lean mince and chicken breasts. A similar relationship is seen in areas with health, crime and employment deprivation.
- In respect of areas considered on a measure of health deprivation then 25 of the 35 items in the HEISB show an association between availability and degree of health deprivation, with 13 (37% of the HEISB items) of these showing a trend towards lower availability as deprivation increases.
- When access is considered in respect of urban and rural communities the pattern is complex. It is notable that in a comparison of urban deprived areas and rural deprived areas the access to HEISB items is better in the rural deprived areas.

Table 29: Paired analysis of proportion of HEISB items available by environmental setting

Shaded areas indicated statistically significant differences at p=0.05 or less

Sentinel ID	UR2	UR1	UR3		ST1	ST2		RD1	RA1		IS2	IS1	
Sentinel Environment	Urban D	Urban A	Urban M	p value	Small Town D	Small Town A	p value	Rural D	Rural A	p value	Island M	Island M/D	p value
Food items FRUIT													
Apples	43.5	25.6	51.4	0.033	50.0	50.0	1.000	80.0	48.4	0.013	80.0	70.0	0.212
Bananas	47.0	25.6	51.4	0.027	43.8	45.8	0.877	80.0	43.8	0.005	76.2	70.0	0.491
White grapes	26.1	15.4	30.0	0.238	25.0	33.3	0.495	70.0	31.3	0.002	66.7	36.7	0.003
Oranges	37.4	18.0	47.1	0.010	37.5	45.8	0.530	80.0	50.0	0.018	81.0	70.0	0.212
Orange juice	76.5	51.3	64.3	0.009	53.1	41.7	0.396	75.0	53.1	0.083	73.8	75.0	0.892
Pineapple	59.1	38.5	62.9	0.036	59.4	41.7	0.189	80.0	35.9	0.001	81.0	68.3	0.155
Frozen berries	9.6	15.4	14.3	0.494	6.3	12.5	0.417	25.0	7.8	0.038	16.7	30.0	0.123
VEGETABLES													
Onions	55.7	33.3	52.9	0.051	56.3	45.8	0.440	85.0	56.3	0.020	83.3	73.3	0.234
Carrots	36.5	28.2	45.7	0.177	50.0	45.8	0.757	85.0	51.6	0.008	78.6	71.7	0.431
Broccoli	15.7	15.4	24.3	0.296	28.1	37.5	0.457	70.0	37.5	0.011	69.1	43.3	0.010
Round lettuce	23.5	18.0	30.0	0.348	31.3	37.5	0.625	65.0	37.5	0.031	66.7	40.0	0.008
Red pepper	18.3	12.8	27.1	0.158	25.0	33.3	0.495	70.0	34.4	0.005	64.3	45.0	0.055
Tomatoes	47.0	35.9	45.7	0.475	56.3	41.7	0.280	80.0	50.0	0.018	78.6	58.3	0.033
Cucumber	27.8	15.4	28.6	0.255	34.4	41.7	0.577	65.0	37.5	0.031	69.1	40.0	0.004
Sweetcorn	15.7	12.8	12.9	0.835	21.9	20.8	0.925	10.0	20.3	0.293	50.0	20.0	0.001
baked beans	79.1	61.5	74.3	0.093	68.8	45.8	0.085	85.0	50.0	0.006	85.7	80.0	0.456
Frozen peas	41.7	38.5	41.4	0.935	46.9	37.5	0.483	80.0	32.8	<0.001	76.2	58.3	0.062
CARBOHYDRATES													
Potatoes	60.0	25.6	50.0	0.001	37.5	45.8	0.530	85.0	45.3	0.002	85.7	73.3	0.135
Weetabix	66.1	48.7	64.3	0.143	59.4	50.0	0.485	65.0	40.6	0.056	81.0	63.3	0.055
Oats	60.0	53.9	58.6	0.797	62.5	41.7	0.122	75.0	48.4	0.037	81.0	71.7	0.283
Spaghetti	67.0	51.3	64.3	0.210	62.5	45.8	0.214	75.0	46.9	0.028	83.3	73.3	0.234
White rice	55.7	30.8	54.3	0.021	53.1	45.8	0.589	75.0	45.3	0.020	85.7	70.0	0.066
Brown rice	7.0	7.7	11.4	0.560	18.8	20.8	0.846	15.0	12.5	0.772	28.6	23.3	0.550
Brown rolls	27.0	33.3	52.9	0.002	40.6	58.3	0.189	70.0	45.3	0.054	73.8	38.3	<0.001
Wholemeal bread	59.1	53.9	61.4	0.741	53.1	62.5	0.483	75.0	50.0	0.049	76.2	55.0	0.028
Oven chips	50.4	28.2	47.1	0.052	50.0	41.7	0.536	80.0	31.3	<0.001	73.8	61.7	0.200

Table 29 continued: Paired analysis of proportion of HEISB items available by environmental setting
Shaded areas indicated statistically significant differences at p=0.05 or less

Sentinel ID	UR2	UR1	UR3		ST1	ST2		RD1	RA1		IS2	IS1	
Sentinel Environment	Urban D	Urban A	Urban M	p value	Small Town D	Small Town A	p value	Rural D	Rural A	p value	Island M	Island M/D	p value
Food items MEALS													
Birds eye lasagne	36.5	15.4	37.1	0.036	25.0	33.3	0.495	40.0	25.0	0.195	47.6	46.7	0.924
PROTEIN													
Chicken breasts	21.7	25.6	28.6	0.569	25.0	37.5	0.314	65.0	23.4	0.001	52.4	41.7	0.285
Lean beef mince	19.1	25.6	34.3	0.069	25.0	29.2	0.728	55.0	21.9	0.005	40.5	60.0	0.052
Salmon fillets	10.4	23.1	15.7	0.137	12.5	29.2	0.120	15.0	10.9	0.624	21.4	15.0	0.402
Haddock fillets	12.2	25.6	12.9	0.106	12.5	37.5	0.028	30.0	10.9	0.040	50.0	58.3	0.405
DAIRY													
Semi-skimmed milk	80.9	76.9	77.1	0.783	81.3	58.3	0.060	80.0	59.4	0.093	83.3	75.0	0.314
Skimmed milk	20.0	30.8	25.7	0.349	25.0	37.5	0.314	70.0	25.0	<0.001	54.8	31.7	0.020
Low fat yoghurt	47.8	30.8	55.7	0.043	37.5	37.5	1.000	70.0	45.3	0.054	73.8	53.3	0.036
Low fat spread	39.1	33.3	27.1	0.247	25.0	37.5	0.314	60.0	25.0	0.004	47.6	36.7	0.269

3.3. HEISB price variation

3.3.1. Key points

- Items with the greatest price variability are frozen peas, brown rice and spaghetti.
- Those with the least are semi-skimmed milk, oven chips, salmon and beef mince.
- Less common items such as frozen berries and grapes have larger absolute price ranges but lower relative variability.
- On an area basis there is no evidence of urban "food deserts" by price.
- The two affluent small town sentinel sites were the cheapest places to purchase the total HEISB basket with rural deprived and island mixed/deprived the two most expensive.
- There was no firm evidence of deprived areas being more expensive across the total HEISB but the affluent sentinels are associated with lower prices in 33 of the 35 items in the HEISB.
- In general price seems to rise with deprivation across quintiles 1,2,3,4 then in quintile 5 it falls.

3.3.2. Price variation by item

A descriptive summary of the price distribution of each individual item in the HEISB for all 466 sentinel stores surveyed is shown in Table 30. This table shows the number of times each designated food item appears, the minimum, maximum, mean and median price as well as the standard deviation, inter-quartile range and coefficient of variation. The latter, following White *et al* (2004), was calculated by dividing the inter-quartile range by the median. The price of many of these food items is highly variable. More ubiquitous items such as apples, oranges and bananas tend to have the smallest price ranges and inter-quartile ranges and have limited price variability.

Items with the greatest price variability are frozen peas, brown rice and spaghetti; those with the least are semi-skimmed milk, oven chips, salmon and beef mince. Less common items such as frozen berries and grapes have larger ranges but lower relative variability.

Previous work has highlighted that the price distributions for some food items are bi or multi-modal (White *et al*, 2004) and this is the case in this study. These differences in modality may be, in part, due to market segmentation of store formats expressed through differing pricing strategies and product differentiation amongst stores.

Table 30: Price (pence) of food items in HEISB

Food items	n	Mean	SD	Minimum	Maximum	Median	IQ range	Coeff Var
FRUIT		**976**		**248**	**2194**	**960**		
White grapes	152	309	111	53	700	298	221-363	47.90
Frozen berries	66	232	81	66	499	241	177-26	34.94
Bananas	235	140	48	44	304	139	95-165	50.50
Apples	245	136	38	22	281	125	109-156	37.80
Orange juice	298	80	25	33	199	81	62-99	45.68
Pineapple	269	52	14	20	145	51	43-59	30.71
Oranges	225	27	9	10	66	25	20-31	44.00
VEGETABLES		**1323**		**417**	**3142**	**1273**		
Red pepper	145	368	101	104	619	375	305-436	34.93
Broccoli	146	210	93	58	707	193	151-248	50.24
Tomatoes	237	180	68	74	520	165	126-218	55.73
Frozen peas	213	173	75	43	360	158	113-234	77.24
Carrots	231	86	27	30	187	83	65-99	40.96
Cucumber	163	79	24	34	210	78	66-90	30.77
Onions	269	80	29	24	250	70	62-94	45.71
Round lettuce	155	56	20	20	120	52	42-64	43.04
Sweetcorn	91	46	13	17	69	50	34-57	45.76
Baked beans	331	45	15	13	100	49	35-49	28.57
CARBOHYDRATES		**948**						
Weetabix	282	167	41	85	378	169	129-194	38.46
Oats	284	150	58	38	338	149	103-189	57.38
Oven chips	230	126	33	35	278	129	109-139	22.57
Brown rolls	199	113	38	39	240	108	79-138	54.63
Wholemeal bread	268	95	35	35	216	96	79-109	31.25
Brown rice	66	101	44	30	199	92	69-128	64.13
White rice	263	75	30	25	200	72	55-86	43.06
Spaghetti	297	63	27	16	200	69	40-85	65.22
Potatoes	259	58	24	20	173	50	43-69	51.60
MEALS		**200**		**89**	**315**	**195**		
Birds eye lasagne	158	200	53	89	315	195	169-228	30.26
PROTEIN		**1018**		**428**	**1999**	**997**		
Salmon fillets	67	282	83	155	559	279	232-310	27.73
Lean beef mince	142	256	55	124	410	269	219-290	26.21
Haddock fillets	110	273	81	89	468	264	214-334	45.41
Chicken breasts	144	207	70	60	562	185	177-230	28.71
DAIRY		**289**		**119**	**785**	**280**		
Low fat spread	163	119	51	38	478	112	99-135	32.14
Semi-skimmed milk	343	73	13	38	120	73	65-80	20.55
Skimmed milk	140	69	16	35	131	66	58-80	33.51
Low fat yoghurt	230	28	8	8	56	29	24-32	28.00

The mean price for each item has been summed by food group to produce a group mean shown in bold. These food group totals are shown separately in Table 31.

Table 31: Food group price percentage of HEISB

	n	Group price	Percent of basket
Fruit	7	976	20.5%
Vegetable	10	1323	27.8%
Carbohydrate	9	948	19.9%
Meal	1	200	4.2%
Protein	4	1018	21.4%
Dairy	4	289	6.1%
Total HEISB	35	4754	

3.3.3. Price variation by store type

Table 32 shows the median price of food items in HEISB by store type across all 466 sentinel shops surveyed. Shopping in large general food stores yields the cheapest median price for the total basket of food items in our survey compared to other general stores, specialist stores and stores where food is secondary. There appears to be a price gradient within general stores with median total basket price increasing as the store gets smaller. Shopping exclusively at specialist stores for individual items in the basket would incur a premium and is the most expensive store format for purchasing food in this survey.

For individual food items the type of store where food is sold is important in determining price. For all but four of the items included in HEISB there is a statistically significant difference in median price between store formats (Kruskal-Wallis test). However this is not to say that shopping in general stores will always be cheaper than shopping at specialists such as fishmongers or greengrocers. Though in the majority of cases food is cheaper in the general store formats, some fresh items such as cucumbers and red peppers are cheaper in specialist outlets. Other items that are cheaper in specialist stores compared to large general stores include ready-made lasagne, chicken breasts and salmon.

The summed median prices for each food group are shown in bold. These summations are not statistically testable.

Table 32 Median price (pence) of food items in HEISB by store type

Food items	Large general	Medium general	Small general	Specialist	Food secondary	KW Chi Squared	p value
FRUIT	**715**	**784**	**1003**	**1051**	**-**		
Orange juice	38	44	85	89	94	85.11	0.0001
Bananas	85	89	149	150	163	83.03	0.0001
Pineapple	35	40	53	58	52	57.77	0.0001
Apples	98	107	135	144	188	45.96	0.0001
Oranges	19	20	29	27	38	45.89	0.0001
White grapes	199	237	311	315	450	34.31	0.0001
Frozen berries	241	247	241	268	-	4.14	0.2464
VEGETABLES	**1046**	**1113**	**1341**	**1350**	**-**		
Baked beans	15	19	49	49	51	90.55	0.0001
Frozen peas	92	99	178	240	231	67.05	0.0001
Carrots	52	59	87	90	100	55.62	0.0001
Tomatoes	109	119	178	199	167	49.22	0.0001
Onions	51	65	79	79	163	34.79	0.0001
Round lettuce	42	41	58	48	-	31.22	0.0001
Broccoli	138	159	212	196	-	20.18	0.0002
Cucumber	75	75	79	63	-	14.41	0.0024
Red pepper	425	425	369	331	469	9.62	0.0474
Sweetcorn	47	52	52	55	-	1.69	0.6389
CARBOHYDRATES	**567**	**682**	**973**	**982**	**-**		
Weetabix	133	128	170	172	184	41.95	0.0001
Oats	57	89	169	140	215	58.09	0.0001
Spaghetti	22	23	69	79	80	99.48	0.0001
White rice	38	45	75	89	66	93.02	0.0001
Brown rice	53	95	92	85	-	11.49	0.0093
Brown rolls	75	75	120	123	129	51.41	0.0001
Wholemeal bread	48	52	99	105	158	67.52	0.0001
Oven chips	100	123	129	129	158	19.02	0.0008
Potatoes	41	52	50	60	47	4.98	0.2897
MEALS	**228**	**230**	**189**	**174**	**189**		
Birds eye lasagne	228	230	189	174	189	17.07	0.0019
PROTEIN	**977**	**984**	**977**	**1097**	**-**		
Lean beef mince	193	269	269	291	-	20.69	0.0001
Haddock fillets	266	246	249	334	-	12.49	0.0059
Chicken breasts	234	180	180	203	-	9.40	0.0244
Salmon fillets	284	289	279	269	-	2.34	0.5044
DAIRY	**215**	**237**	**300**	**321**	**-**		
Semi-skimmed milk	56	58	75	82	75	76.85	0.0001
Low fat spread	88	93	124	125	124	60.43	0.0001
Low fat yoghurt	16	28	31	34	27	40.37	0.0001
Skimmed milk	55	58	70	80	80	38.69	0.0001
HEISB TOTAL	**3748**	**4030**	**4783**	**4975**	**-**		

Shaded areas indicated statistically significant differences at p=0.05 or less

There is a caveat to the prices presented here. Though we have a median price for each item in the basket, there may be some areas without access to all these kinds of stores. Similarly the stores where food is secondary (food secondary) only carry a limited range of items and so could never be used to source all food items in the basket.

3.3.4. Price variation by sentinel

Table 33 shows the variation in price for the total basket and for each individual food item by each of the nine sentinel sites. As noted above each sentinel site was selected on the basis of rurality and deprivation and this is reflected in the labels for each site column. The shaded lines in the table indicate those food items where there is a statistically significant difference in median price between sites (Kruskal Wallis test). As expected, there is statistically significant variation in median price by site for twenty-five of the thirty-five items in the basket. Although items in the protein group of food do differ in price by site this does not reach conventional statistical significance. The two affluent small town sentinel sites were the cheapest places to purchase the total HEISB basket with rural deprived and island mixed/deprived the two most expensive. The urban deprived study site fared relatively well and was cheaper or as cheap as rural and island sites irrespective of their deprivation status, and was also cheaper than the small town deprived site.

For individual food items these associations generally remained true with small town affluent being the cheapest for twenty-five of the thirty-five individual food items. The foods that were cheaper elsewhere were pineapples (urban affluent), bananas (urban affluent), cucumber (urban affluent), round lettuce (urban affluent), brown rice (urban affluent), wholemeal bread (urban affluent), oven chips (urban affluent/rural deprived), lasagne (island mixed), haddock (urban deprived) and skimmed milk (urban affluent). As can be seen in this list the affluent sentinels are associated with lower prices in 33 of the 35 items in HEISB.

Table 33: Median price (pence) of food items in HEISB by sentinel site

Sentinel ID	UR2	UR1	UR3	ST1	ST2	ST2	RD1	RA1	IS2	IS1	KW Chi Squared	p value
Sentinel environment	Urban D	Urban A	Urban M	Small town D	Small town A	Small town A	Rural D	Rural A	Island M	Island M/D		
FRUIT	867	856	866	940	808	840	1265	936	846	1029		
Orange juice	85	87	85	65	67	48	99	79	68	89	43.66	0.0001
Apples	125	102	135	131	112	147	169	125	113	147	33.27	0.0001
Frozen berries	182	182	233	274	174	247	335	240	150	260	26.33	0.0018
Pineapple	55	43	45	59	47	55	59	48	51	52	17.80	0.0375
Bananas	130	100	118	137	105	109	160	126	140	152	17.20	0.0456
Oranges	25	20	26	25	24	16	34	25	25	30	22.42	0.0076
White grapes	265	323	225	249	280	218	410	293	299	299	14.00	0.1225
VEGETABLES	1202	1206	1268	1317	1184	1093	1353	1175	1135	1413		
Cucumber	79	54	75	59	79	83	99	60	69	87	63.73	0.0001
Red pepper	375	406	469	403	380	331	375	340	244	431	40.91	0.0001
Onions	70	86	80	77	57	67	80	65	60	88	35.33	0.0001
baked beans	49	49	49	38	31	18	49	49	49	50	33.33	0.0001
Frozen peas	129	125	135	168	129	99	138	178	129	180	27.31	0.0012
Round lettuce	45	39	49	44	42	48	65	46	56	62	30.79	0.0003
Sweetcorn	57	39	39	39	27	54	36	34	52	55	28.24	0.0009
Broccoli	159	127	155	209	212	219	203	177	232	212	19.07	0.0246
Carrots	79	88	65	85	59	59	99	79	83	89	13.81	0.1293
Tomatoes	160	193	152	196	168	115	210	147	161	159	13.14	0.1565
CARBOHYDRATES	951	797	891	899	841	852	946	905	944	1015		
Potatoes	45	54	65	56	54	40	69	54	50	60	34.38	0.0001
Weetabix	179	166	170	159	145	143	170	179	129	178	32.13	0.0002
Oats	169	143	129	129	159	112	127	140	123	159	17.39	0.0429
Spaghetti	69	47	45	67	34	29	61	63	78	83	24.89	0.0031
White rice	79	46	67	74	65	54	79	69	55	84	38.54	0.0001
Brown rice	90	50	69	103	95	129	69	79	149	95	17.39	0.0429
Brown rolls	96	90	120	90	79	104	153	103	132	129	40.85	0.0001
Wholemeal bread	96	83	91	92	87	99	99	90	99	98	9.72	0.3739
Oven chips	129	119	135	129	124	142	119	129	129	129	16.75	0.0528

D=deprived; M=mixed; A=affluent; Shaded areas indicated statistically significant differences at p=0.05 or less

Table 33 continued: Median price (pence) of food items in HEISB by sentinel site

Sentinel ID	UR2	UR1	UR3	ST1	ST2	ST2	RD1	RA1	IS2	IS1	KW Chi Squared	p value
Sentinel environment	Urban D	Urban A	Urban M	Small town D	Small town A	Small town A	Rural D	Rural A	Island M	Island M/D		
MEALS	179	185	199	234	249	199	199	299	162	198		
Birds eye lasagne	179	185	199	234	249	199	199	299	162	198	27.26	0.0013
PROTEIN	910	1046	1012	1064	918	1003	1202	1078	942	970		
Chicken breasts	185	243	198	182	170	197	273	180	181	181	13.42	0.1447
Haddock fillets	226	255	266	334	330	294	323	316	284	241	12.13	0.2063
Lean beef mince	269	269	269	269	169	269	275	275	233	269	11.63	0.2352
Salmon fillets	230	280	279	279	249	243	330	308	244	279	12.21	0.2615
DAIRY	278	270	275	272	238	243	310	274	313	293		
Low fat yoghurt	30	26	29	29	16	28	33	30	29	32	36.70	0.0001
Skimmed milk	61	55	62	64	67	55	69	67	80	71	26.64	0.0016
Semi-skimmed milk	69	72	75	70	66	64	74	68	80	76	19.03	0.0249
Low fat spread	118	118	109	109	90	97	135	109	124	115	16.61	0.0552
HEISB TOTAL	4387	4360	4511	4725	4238	4230	5275	4668	4341	4918		

D=deprived; M=mixed; A=affluent; Shaded areas indicated statistically significant differences at p=0.05 or less

3.3.5. Price variation by deprivation

We also investigated how median price varies by deprivation across data zones in our sentinel sites. Table 34 shows the median price of HEISB items by quintile of deprivation (SIMD 2006).

Table 34: Median price (pence) of food items in HEISB by deprivation

Food items	1 (affluent)	2	3	4	5 (deprived)	KW Chi Sq	p value
FRUIT	**870**	**898**	**960**	**1005**	**885**		
Frozen berries	175	184	256	241	187	10.41	0.0341
Bananas	125	140	143	150	123	10.07	0.0392
Orange juice	75	71	88	87	87	7.03	0.1344
Oranges	25	27	25	30	25	3.56	0.4691
Pineapple	47	52	49	50	53	2.84	0.5847
Apples	125	125	125	138	125	2.31	0.6797
White grapes	298	300	274	310	285	0.58	0.9656
VEGETABLES	**1229**	**1197**	**1327**	**1372**	**1235**		
Cucumber	70	69	79	82	79	20.54	0.0004
Frozen peas	158	159	170	180	124	15.84	0.0032
Onions	69	65	78	88	72	15.52	0.0037
Red pepper	369	313	403	406	407	11.39	0.0226
Sweetcorn	39	50	39	55	54	9.27	0.0547
Baked beans	49	49	49	49	48	7.36	0.1181
Broccoli	189	176	209	212	159	6.40	0.1712
Round lettuce	46	53	56	51	45	4.76	0.3124
Carrots	83	83	85	85	80	1.55	0.8187
Tomatoes	158	181	160	163	167	1.346	0.8535
CARBOHYDRATES	**873**	**899**	**957**	**995**	**943**		
Brown rolls	99	120	128	132	96	16.17	0.0028
White rice	67	65	69	79	79	15.65	0.0035
Potatoes	58	50	55	54	45	11.92	0.0180
Spaghetti	45	69	67	69	69	7.87	0.0964
Oats	129	129	154	175	166	6.49	0.1655
Oven chips	129	129	125	129	129	6.28	0.1793
Brown rice	95	79	95	95	85	3.36	0.4993
Weetabix	162	159	169	169	178	2.26	0.6890
Wholemeal bread	89	99	96	93	96	2.04	0.7278
MEALS	**214**	**172**	**199**	**191**	**185**		
Birds eye lasagne	214	172	199	191	185	4.04	0.4012
PROTEIN	**1001**	**1026**	**1006**	**925**	**908**		
Haddock fillets	272	283	273	213	248	6.17	0.1866
Chicken breasts	181	195	185	185	180	4.23	0.3760
Lean beef mince	269	269	269	269	220	4.14	0.3873
Salmon fillets	279	280	279	257	261	3.31	0.5080
DAIRY	**274**	**302**	**277**	**293**	**269**		
Skimmed milk	64	76	70	66	58	12.62	0.0133
Semi-skimmed milk	72	79	69	75	70	7.20	0.1256
Low fat yoghurt	29	29	29	31	29	6.13	0.1897
Low fat spread	109	118	109	122	112	3.22	0.5222
HEISB TOTAL	**4460**	**4494**	**4725**	**4781**	**4424**		

Shaded areas indicated statistically significant differences at p=0.05 or less

From this pooled data, sourcing all HEISB items from shops located in the most deprived quintile gave the cheapest total basket price of 4424 (£44.24). This is affected by the relatively large number (12) of large and medium sized stores in the total of shops in areas in the deprived quintile. Taking this factor into account and considering the prices pattern across the other 4 quintiles there is a price gradient from £44.60 in quintile 1 (most affluent) to £47.81 in quintile 4 (more deprived).

We explored associations between quintile of deprivation and the price of each individual food item. Quintile of deprivation was associated with price for ten of the thirty-five items in our basket; 2/7 fruit items; 3/10 vegetable items; 3/9 carbohydrate items and 1/4 dairy items. Items in the protein and meal groups were not significantly associated with quintile of deprivation. For those items that were significantly associated with deprivation nine of the ten items were most expensive in quintiles 3, 4 or 5. Frozen berries and bananas were most expensive in quintiles 3 and 4 respectively; cucumbers, frozen peas, onions were most expensive in quintile 4, red peppers in quintile 5; brown rolls and white rice in quintile 4, potatoes in quintile 3; skimmed milk in quintile 2. The remaining items varied widely in price across the deprivation categories but were not significantly associated with deprivation quintile.

The global measure of deprivation used in this analysis (SIMD 2006) is derived from seven individual components which reflect the multi-dimensional nature of deprivation. These components include income, employment, health, education training and skills, housing, geographic access and crime. We investigated whether price was patterned by these individual components of deprivation by dividing data zones in the study sample into quintiles for each individual deprivation component. Variation in median price for each food item by each of these component indicators of deprivation was then assessed. It should be noted that each deprivation component cannot be directly compared against another as the data zone rank order for each component differs. Tables are presented in Appendix 12 (Appendix Tables 21-27).

The total basket price of all HEISB items was cheapest in the quintile with highest income deprivation (£43.72), second cheapest in the quintile with the lowest income deprivation (£44.14) and most expensive in quintile 3 (£47.35). Price seems to rise with deprivation across quintiles 1,2,3,4 then in quintile 5 it falls (Appendix Table 21).

When looking at individual food items, there was evidence of an association between income deprivation and price in twelve items: 6/10 vegetable items, 4/9 carbohydrates, 1/4 protein items and 1/4 dairy items. There was no consistent pattern in these associations, with brown rolls, potatoes and skimmed milk being most expensive in quintile 2, cucumber and frozen peas in quintile 3, onions, red peppers and chicken breasts in quintile 4 and sweetcorn and oats in quintile 5 of highest income deprivation.

Appendix Table 22 shows the variation in price for the total basket and individual food items by employment deprivation. The total basket was cheapest in the quintile of highest employment deprivation, second cheapest in quintile 1 of lowest deprivation and most expensive in quintile 3. There was little evidence of association of employment deprivation with the price of individual food items, with 1/7 fruits, 1/10 vegetables and 3/9 carbohydrate items showing statistically significant differences in median prices. Bananas, frozen peas and brown rolls were most expensive in quintile 3, potatoes in quintile 2 and white rice in quintile 5, therefore showing no clear pattern to these associations.

When analysed by health quintiles, there was little evidence of association with pricing (Appendix Table 23). The cheapest basket of all food items was located in the quintile with worst health, second cheapest in the quintile with best health and most expensive in quintile 4. The pricing of individual food items demonstrated statistically significant differences by health in 1/7 fruit items,

3/10 vegetable items, 2/9 carbohydrates and 1/4 dairy items. Bananas, frozen peas, brown rolls and skimmed milk were most expensive in quintile 2 and red peppers, cucumber and potatoes in quintile 4.

The variation in median price by level of education, training and skills demonstrated little evidence of an association with pricing (Appendix Table 24). The total basket was cheapest in the quintile with highest level of education, second cheapest in quintile 2 and most expensive in quintile 3. Four individual food items showed evidence of an association, 1/7 fruit items, 1/10 vegetable items and 2/7 carbohydrates. White grapes and oats were most expensive in the quintile with lowest education (quintile 5), onions in quintile 4 and brown rolls in the quintile of highest education.

Appendix Table 25 shows the variation in pricing by level of housing deprivation. The total basket price was cheapest in the most deprived quintile, second cheapest in the least deprived quintile and most expensive in quintile 3. Six individual food items showed evidence of an association between housing deprivation and price, including 2/7 fruit items, 1/10 vegetables and 3/9 carbohydrates. Frozen berries and potatoes were most expensive in quintile 2 and oranges and broccoli in quintile 3.

Geographic access appears to be the component of deprivation most strongly associated with price (Appendix Table 26). Total basket price was cheapest for data zones with the highest access (quintile 1), second cheapest in quintile 4 and most expensive in quintile 3, therefore showing no clear pricing pattern in the HEISB basket as a whole. However, price variations in individual food items were more apparent with fifteen items demonstrating statistically significant differences by geographic access, including 2/7 fruits, 8/10 vegetables, 3/9 carbohydrates and 2/4 dairy products. Bananas, round lettuce, frozen peas, cucumber, sweetcorn, carrots, brown rolls, spaghetti, semi-skimmed milk and low fat yoghurt were most expensive in areas with poor access (quintile 5), and oranges, broccoli and oats in quintile 3. A consistent pricing pattern is apparent, with food items tending to be more expensive in quintiles with poor access and cheaper in quintiles with good access

Crime was the final component of deprivation used in SIMD, and although few individual food items were statistically significantly associated with pricing, there appeared to be a pattern to the direction of association (Appendix Table 27). The total food basket was cheapest in the quintile with the highest crime levels (quintile 5), second cheapest in quintile 3 and most expensive in quintile 1. Five individual food items were associated with crime levels, including 1/7 fruit items and 4/10 vegetable items. Frozen peas and round lettuce were most expensive in the quintile with lowest crime levels (quintile 1) and frozen berries and carrots in quintile 2. Even in the items that did not display statistically significant differences, the pattern in the price variation seems to be fairly consistent, with items being more expensive in quintiles with low crime levels and cheaper in areas with high crime levels.

3.3.6. Environmental setting and price

The nine sentinel sites were purposively chosen to vary in terms of their environment. The four environmental settings used in this study were island, rural, small town and urban and within each of these settings affluent and deprived sentinel areas were selected. Table 35 shows the results of a comparative analysis of mean price of food items by setting in order to investigate differences in price by deprivation within similar environments.

For urban environments there were three locations, deprived, affluent and mixed. In contrast to the other environments the deprived location was the cheapest in total for HEISB with affluent location the next cheapest and the mixed location the most expensive. Here, eleven of the thirty-five items in

the HEISB were cheaper in the deprived location compared to the affluent and mixed areas. The cheaper items were white grapes, frozen berries, onions, red peppers, tomatoes, potatoes, brown rolls, chicken breasts, lean beef mince, salmon and haddock fillets. Of these eleven items, four were significantly different in mean price (red peppers, potatoes, brown rolls and chicken breasts). In total, ten of the thirty-five items differed significantly in price with the six which were more expensive in the deprived location being apples, pineapple, sweetcorn, spaghetti, long grained rice and oven chips.

In the second environment, small town settings, the HEISB was more expensive in the deprived compared to the affluent location. There were fewer statistically significant differences in individual mean food price for this setting with only two items, cucumbers (less expensive in the deprived location) and frozen peas (more expensive in the deprived location), reaching significance. Seven items in total were less expensive in the deprived location; apples, white grapes, round lettuce, tomatoes, cucumber, brown rice and brown rolls.

In rural settings, the deprived location was more expensive (£54.13) than the affluent location (£48.54) for HEISB. Twenty-seven of the thirty-five items were cheaper in the more affluent sentinel location, nine significantly so. These items were apples, white grapes, oranges, orange juice, frozen berries, round lettuce, tomatoes, cucumber and brown rolls. The eight items that were cheaper in the more deprived location were sweetcorn, baked beans, oats, brown rice, lasagne, lean beef mince, salmon and haddock, but these differences were not statistically significant.

For island settings, the HEISB was more expensive in the mixed/deprived site (£50.44) than the affluent site (£45.06). Twenty-eight of the thirty-five items in the basket were cheaper in the more affluent sentinel site. Those items that were cheaper in the more deprived site were tomatoes, brown rice, wholemeal bread, haddock, semi-skimmed milk and low fat spread.

However none of these items were significantly different in price (t-test). Ten items were significantly more expensive in the more mixed/deprived location; apples, oranges, orange juice, frozen berries, onions, red peppers, cucumbers, weetabix, long grain rice and low fat yoghurt.

If the prices of the 6 food groups are compared on the basis of deprived v. affluent sentinel in the 3 environmental settings (rural, small town and urban) then for the 14/18 (6x3) comparisons the price is higher in the deprived setting (77.8%).

Table 35: Paired analysis of mean price (pence) of food items by environmental setting

Sentinel ID	UR2	UR1	UR3		ST1	ST2		RD1	RA1		IS2	IS1	
Sentinel environment	Urban D	Urban A	Urban M	p value	Small town D	Small town A	p value	Rural D	Rural A	p value	Island M	Island M/D	p value
FRUIT	**896**	**883**	**978**		**956**	**854**		**1276**	**943**		**863**	**1072**	
Apples	131	109	146	0.0202	140	140	0.9906	167	132	0.0080	119	146	0.0001
Bananas	142	117	128	0.2566	136	126	0.6494	159	135	0.0638	137	154	0.0967
White grapes	281	300	331	0.3415	254	255	0.9582	399	293	0.0181	298	337	0.1575
Oranges	24	22	26	0.3787	27	23	0.2514	35	27	0.0108	26	30	0.0192
Orange juice	81	75	83	0.4243	70	61	0.3736	104	82	0.003	64	84	<0.0001
Pineapple	54	48	47	0.0137	56	51	0.3490	55	53	0.7543	51	52	0.5552
Frozen berries	183	213	217	0.4547	274	199	0.1379	356	221	0.0183	169	268	0.0075
VEGETABLES	**1271**	**1282**	**1325**		**1348**	**1234**		**1500**	**1247**		**1236**	**1463**	
Onions	82	90	85	0.7060	79	72	0.4303	85	75	0.1959	60	89	<0.0001
Carrots	80	91	80	0.4759	91	78	0.2361	95	84	0.1897	85	93	0.2161
Broccoli	206	168	199	0.7990	222	210	0.7267	239	180	0.0937	218	230	0.6349
Round lettuce	52	51	46	0.4519	46	51	0.4645	68	52	0.0246	61	67	0.3258
Red pepper	347	396	435	0.0415	395	358	0.2882	392	353	0.2058	267	421	<0.0001
Tomatoes	169	190	177	0.4951	183	191	0.8357	231	168	0.0049	179	176	0.8453
Cucumber	83	72	77	0.3740	66	86	0.0160	108	59	<0.0001	70	93	0.0001
Sweetcorn	54	35	36	0.001	41	40	0.8814	36	40	0.6245	50	52	0.6109
Baked beans	45	42	45	0.6862	35	29	0.2178	47	48	0.8088	46	50	0.2598
Frozen peas	154	146	147	0.8782	191	119	0.0242	200	187	0.6173	199	193	0.7105
CARBOHYDRATES	**952**	**856**	**926**		**941**	**875**		**1003**	**933**		**934**	**999**	
Potatoes	50	60	68	0.0009	56	53	0.7919	71	58	0.064	54	65	0.0634
Weetabix	172	161	170	0.5481	160	156	0.8656	180	180	1.0000	140	175	0.0001
Oats	170	153	152	0.2788	131	121	0.6177	151	152	0.9559	127	146	0.0799
Spaghetti	64	59	52	0.0395	64	45	0.0784	71	63	0.3917	68	72	0.4027
White rice	82	52	78	0.0208	81	58	0.0696	78	71	0.2329	61	84	0.0003
Brown rice	107	90	70	0.2829	116	117	0.9488	70	80	0.4571	131	100	0.0683
Brown rolls	87	99	116	0.0031	98	108	0.5287	145	116	0.0136	125	129	0.6730
Wholemeal bread	94	85	91	0.6095	99	97	0.8613	112	96	0.2497	98	96	0.7766
Oven chips	126	99	129	0.0401	137	121	0.3938	125	117	0.4321	129	131	0.7403

Shaded areas indicated statistically significant differences at p=0.05 or less

Table 35 continued: Paired analysis of mean price (pence) of food items by environmental setting

Sentinel ID	UR2	UR1	UR3		ST1	ST2		RD1	RA1		IS2	IS1	
Sentinel environment	Urban D	Urban A	Urban M	p value	Small town D	Small town A	p value	Rural D	Rural A	p value	Island M	Island M/D	p value
MEALS	**191**	**184**	**198**		**230**	**206**		**206**	**257**		**175**	**191**	
Birds eye lasagne	191	184	198	0.7411	230	206	0.4714	206	257	0.0563	175	191	0.1975
PROTEIN	**919**	**1061**	**1020**		**1094**	**964**		**1103**	**1191**		**973**	**1014**	
Chicken breasts	185	237	203	0.0321	222	185	0.4077	240	223	0.5910	184	213	0.1762
Lean beef mince	247	267	254	0.7506	273	234	0.1615	258	281	0.1828	240	261	0.0873
Salmon fillets	249	285	281	0.5424	281	254	0.3467	299	359	0.4119	269	287	0.7111
Haddock fillets	238	273	282	0.4207	318	292	0.6413	306	329	0.6953	281	253	0.1928
DAIRY	**282**	**265**	**268**		**276**	**251**		**325**	**284**		**324**	**304**	
Semi-skimmed milk	72	71	72	0.9332	74	67	0.1490	74	71	0.3372	78	76	0.4362
Skimmed milk	65	59	66	0.5443	70	64	0.3832	71	66	0.2145	79	73	0.2693
Low fat yoghurt	27	23	28	0.1290	27	22	0.1836	32	29	0.0651	28	33	0.0013
Low fat spread	118	112	102	0.3391	105	97	0.5026	148	117	0.2590	140	122	0.3359
HEISB TOTAL	**4511**	**4532**	**4716**		**4845**	**4385**		**5413**	**4854**		**4506**	**5044**	

Shaded areas indicated statistically significant differences at p=0.05 or less

3.3.7. Price variation and combined factors

We explored which factors in our study were most related to the price of food with deprivation, rurality, shop type and seasonality (date of data collection) as our four predictor variables. We entered these variables in a stepwise linear regression model with the price of each individual item in HEISB as the dependent variable.

As Table 36 shows, between them these four predictors explained between 5.36% (potatoes) and 39.6% (orange juice) of the variance in the price of the items in HEISB. There was no consistent pattern of association across the thirty-five individual items or by group. There was evidence of interactions for shop type, rurality and date of data collection with deprivation as the primary exposure variable for grapes, onions, white rice, wholemeal bread, frozen berries, salmon fillets, semi-skimmed milk and low fat yoghurt.

Table 36: Variation in the price of food items explained by deprivation, rurality, shop type and seasonality (%)

Food items	R^2	Food items cont.	R^2
Orange juice	39.60	White grapes	21.20
Spaghetti	37.55	Salmon fillets	21.10
Baked beans	36.30	Oranges	20.85
Brown rolls	35.50	Weetabix	19.84
White rice	34.71	Birds eye lasagne	18.84
Skimmed milk	31.79	Carrots	18.72
Frozen peas	31.02	Red pepper	18.62
Cucumber	30.72	Low fat spread	18.13
Bananas	29.12	Haddock fillets	18.05
Oats	28.40	Onions	17.87
Wholemeal bread	27.86	Sweetcorn	17.77
Low fat yoghurt	27.13	Lean beef mince	17.13
Brown rice	26.97	Oven chips	14.63
Frozen berries	23.98	Tomatoes	14.53
Semi-skimmed milk	23.87	Broccoli	13.37
Apples	23.46	Chicken breasts	9.46
Pineapple	22.73	Potatoes	5.36
Round lettuce	22.57		

Multivariate analysis enabled us to explore the association between deprivation and price whilst controlling for any potential confounding effects of the other explanatory variables. There was some evidence of an association in five food items; the price of potatoes, frozen peas and lean beef mince decreased with increasing deprivation (a classic affordable Scottish dish), whilst the price of broccoli and sweetcorn increased. This association was only apparent in 14% of food items, and demonstrated no consistent pattern in price variation with deprivation.

Once the effects of rurality, shop type and seasonality, along with their interactions, were controlled for, there was little evidence of a true effect of deprivation on the pricing of food items in this sample of stores.

3.4. Promotional activity

3.4.1. Key points

- Chicken breasts, salmon fillets, baked beans, oven chips and low fat yoghurt were the five most heavily promoted items.
- Stores in the urban deprived sentinel have the greatest proportion of items on promotion for each individual food item. This contributes to the lower costs of total baskets in these areas.
- Medium sized general stores showed most promotional activity.
- Areas with a higher rate of promotions tend to be cheaper than areas with a lower rate.

3.4.2. Promotional activity across all stores

We also investigated the patterning of food promotions across the 466 stores in the survey. Table 37 summarises the proportion of HEISB items, in stores that sold that product, that were on promotion during the survey. Chicken breasts, salmon fillets, baked beans, oven chips and low fat yoghurt were the five most heavily promoted items (all above 25% of items) and sweetcorn, brown rice, apples, cucumber and semi-skimmed milk the least heavily promoted (all under 2%).

Table 37: Proportion of individual food items on promotion

Rank	Food items	Frequency	%	Rank	Food items cont.	Frequency	%
1	Chicken breasts	50	34.0	19	Wholemeal bread	13	4.7
2	Salmon fillets	19	26.8	20	Frozen peas	10	4.6
3	Baked beans	86	25.8	21	Oranges	10	4.4
4	Oven chips	59	25.5	22	Round lettuce	6	3.7
5	Low fat yoghurt	59	25.3	23	Potatoes	7	2.7
6	Lean beef mince	30	21.0	24	Red pepper	4	2.7
7	Weetabix	51	18.1	25	Carrots	6	2.5
8	Birds eye lasagne	27	16.7	26	Low fat spread	4	2.4
9	Spaghetti	40	13.5	27	Onions	6	2.2
10	Broccoli	19	12.5	28	Skimmed milk	3	2.1
11	White grapes	17	10.8	29	Bananas	5	2.1
12	Oats	30	10.6	30	Tomatoes	5	2.1
13	White rice	26	9.9	31	Semi-skimmed milk	7	2.0
14	Frozen berries	4	6.0	32	Cucumber	3	1.8
15	Haddock fillets	6	5.3	33	Apples	4	1.6
16	Orange juice	16	5.3	34	Brown rice	1	1.5
17	Pineapple	14	5.2	35	Sweetcorn	1	1.1
18	Brown rolls	10	4.9				

3.4.3. Promotional activity by sentinel

Table 38 shows that urban deprived (32 of 35) and island mixed/deprived settings (26 of 35) had the largest number of individual food items for which the proportion on promotion was greatest, with small town affluent having the fewest (1 of 35; 12 of 35). The prevalence of promotions in these areas has the effect of lowering total basket prices. There were statistically significant differences across the nine sentinel sites for twelve items (orange juice, baked beans, frozen peas, round lettuce, weetabix, white rice, spaghetti, oven chips, brown rolls, lasagne, lean beef mince and low fat yoghurt).

Table 38: Proportion promotions by item by sentinel site

Sentinel ID	UR2	UR1	UR3	ST1	ST2	ST2	RD1	RA1	IS2	IS1	Chi Squared	p value
Sentinel environment	Urban D	Urban A	Urban M	Small town D	Small town A	Small town A	Rural D	Rural A	Island M	Island M/D		
FRUIT												
Orange juice	5.7	5.0	4.4	11.8	0.0	0.0	26.7	0.0	0.0	4.4	19.60	0.021
White grapes	16.7	16.7	28.6	0.0	0.0	25.0	0.0	10.0	0.0	9.1	15.59	0.076
Pineapple	8.8	13.3	11.4	0.0	0.0	0.0	0.0	4.4	0.0	0.0	13.87	0.127
Bananas	0.0	10.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	2.4	13.44	0.144
Frozen berries	27.3	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.29	0.150
Oranges	7.0	14.3	9.1	0.0	0.0	0.0	0.0	0.0	0.0	7.1	9.72	0.373
Apples	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	6.93	0.644
VEGETABLES												
Baked beans	33.0	20.8	15.4	27.3	0.0	0.0	11.8	28.1	61.1	8.3	42.46	<0.001
Frozen peas	4.2	26.7	6.9	6.7	0.0	25.0	0.0	0.0	0.0	0.0	26.51	0.002
Round lettuce	3.7	0.0	19.1	0.0	0.0	0.0	0.0	0.0	0.0	4.2	17.48	0.042
Broccoli	22.2	0.0	23.5	44.4	0.0	0.0	7.1	8.3	6.9	7.7	16.12	0.064
Onions	3.1	15.4	2.7	5.6	0.0	0.0	0.0	0.0	0.0	0.0	15.08	0.089
Red pepper	9.5	0.0	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.44	0.247
Cucumber	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	10.89	0.284
Sweetcorn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	6.74	0.664
Tomatoes	1.9	7.1	0.0	5.6	0.0	0.0	0.0	3.1	0.0	2.9	5.12	0.823
Carrots	4.8	9.1	3.1	0.0	0.0	0.0	0.0	3.0	0.0	2.3	4.87	0.845
CARBOHYDRATES												
Weetabix	9.2	10.5	17.8	21.1	14.3	20.0	0.0	3.9	58.8	18.4	49.49	<0.001
White rice	9.4	8.3	31.6	0.0	0.0	0.0	26.7	3.5	0.00	4.8	34.59	<0.001
Spaghetti	28.6	5.0	22.2	5.0	0.0	0.0	0.0	0.0	5.7	9.1	31.74	<0.001
Oven chips	36.2	20.0	21.2	18.8	0.0	25.0	6.3	0.0	19.4	48.7	27.41	0.001
Brown rolls	6.5	0.0	0.0	23.1	0.0	28.6	0.0	6.9	3.2	0.0	23.17	0.006
Potatoes	2.9	10.0	0.0	0.0	0.0	20.0	11.8	0.0	0.0	2.3	16.59	0.056
Oats	5.8	9.5	9.8	15.0	0.0	25.0	0.0	3.2	23.5	16.3	14.79	0.097
Wholemeal bread	10.3	4.8	7.0	0.0	0.0	14.3	0.0	0.0	0.0	3.0	11.99	0.214
Brown rice	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.49	0.587

D=deprived; M=mixed; A=affluent; Shaded areas indicated statistically significant differences at p=0.05 or less

Table 38 continued: Proportion promotions by item by sentinel site

Sentinel ID	UR2	UR1	UR3	ST1	ST2	ST2	RD1	RA1	IS2	IS1	Chi Squared	p value
Sentinel environment	Urban D	Urban A	Urban M	Small town D	Small town A	Small town A	Rural D	Rural A	Island M	Island M/D		
MEALS												
Birds eye lasagne	19.1	50.0	15.4	0.0	0.0	100.0	0.0	6.3	0.0	25.0	35.65	<0.001
PROTEIN												
Lean beef mince	38.4	30.0	33.3	25.0	0.0	66.7	9.1	14.3	4.0	12.5	17.77	0.038
Chicken breasts	44.0	40.0	35.0	37.5	0.0	75.0	46.2	53.3	13.6	20.0	16.50	0.057
Haddock fillets	15.4	20.0	11.1	0.0	0.0	0.0	0.0	14.3	0.0	0.0	12.95	0.165
Salmon fillets	25.0	22.2	45.5	75.0	0.0	33.3	0.0	28.6	11.1	22.2	10.68	0.298
DAIRY												
Low fat yoghurt	34.6	16.7	41.0	25.0	0.0	0.0	50.0	24.1	0.0	15.6	27.72	0.001
Low fat spread	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.84	0.287
Skimmed milk	4.4	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.0	5.3	5.04	0.831
Semi-skimmed milk	3.2	3.3	3.7	0.0	0.0	0.0	0.0	0.0	0.0	2.2	4.44	0.880

D=deprived; M=mixed; A=affluent; Shaded areas indicated statistically significant differences at p=0.05 or less

3.4.4. Promotional activity by shop type

Table 39 shows promotions by shop type for items in HEISB. Medium general stores had the largest number of individual food items for which the proportion on promotion was greatest (16 of 35 items). This may reflect a greater competitive pressure on medium general stores that compete directly with the larger stores whilst small general stores are in less direct competition with the large stores. Differences across shop categories were statistically significant for nineteen items with five of seven fruit, and six of ten vegetable group items being significantly different.

Table 39: Promotions by item by shop type

	Food items	Large general	Medium general	Small general	Specialist	Food secondary	Chi squared	p value
FRUIT	White grapes	46.2	22.2	5.4	0.0	0.0	26.21	<0.001
	Oranges	23.1	11.5	2.6	0.0	0.0	16.97	0.002
	Bananas	15.4	3.5	1.2	0.0	0.0	13.06	0.011
	Apples	7.7	6.9	0.6	0.0	0.0	9.79	0.044
	Pineapple	0.0	20.0	4.3	0.0	0.0	13.50	0.009
	Frozen berries	7.7	13.3	3.2	0.0	0.0	2.44	0.486
	Orange juice	0.0	7.1	6.1	0.0	0.0	3.06	0.548
VEGETABLE	Tomatoes	0.0	13.8	0.6	0.0	0.0	22.69	<0.001
	Frozen peas	15.4	17.2	1.9	0.0	0.0	17.76	0.001
	Baked beans	0.0	6.9	30.0	25.0	11.1	13.25	0.010
	Onions	0.0	17.2	0.5	0.0	0.0	34.51	<0.001
	Broccoli	23.1	25.9	10.0	3.1	0.0	8.81	0.032
	Carrots	7.7	7.1	1.9	0.0	0.0	5.14	0.274
	Red pepper	0.0	12.5	1.2	0.0	0.0	10.88	0.028
	Sweetcorn	0.0	0.0	1.7	0.0	0.0	0.59	0.898
	Round lettuce	7.7	4.2	3.9	0.0	0.0	1.50	0.683
	Cucumber	0.0	3.7	1.9	0.0	0.0	1.28	0.734
CARBOHYDRATE	Spaghetti	0.0	0.0	17.1	0.0	28.6	14.49	0.006
	Weetabix	23.1	33.3	15.6	33.3	12.5.	7.01	0.135
	Wholemeal bread	7.7	13.8	3.9	1.9	0.0	6.93	0.140
	Brown rice	7.7	0.0	0.0	0.0	0.0	4.22	0.239
	Oven chips	15.4	17.9	26.9	41.7	0.0	4.40	0.354
	Oats	0.0	11.5	11.8	0.0	33.3	8.38	0.079
	Brown rolls	0.0	17.9	3.6	1.9	0.0	12.28	0.015
	White rice	0.0	13.8	10.4	0.0	40.0	9.85	0.043
	Potatoes	0.0	3.6	2.8	2.4	0.0	0.59	0.964
MEAL	Birds Eye lasagne	46.2	38.1	10.8	0.0	0.0	19.62	0.001
PROTEIN	Chicken breasts	7.7	39.3	52.1	0.0	0.0	31.96	<0.001
	Haddock fillets	0.0	21.7	0.0	4.2	0.0	16.30	0.001
	Salmon fillets	33.3	52.4	16.7	5.0	0.0	13.07	0.004
	Lean beef mince	23.1	37.5	25.7	0.0	0.0	14.49	0.002
DAIRY	Semi-skim milk	0.0	7.1	2.0	0.0	0.0	5.20	0.267
	Low fat spread	0.0	7.4	1.7	0.0	0.0	3.59	0.465
	Low fat yoghurt	30.8	28.6	27.3	0.0	0.0	7.51	0.111
	Skimmed milk	0.0	3.7	2.3	0.0	0.0	0.92	0.921

Shaded areas indicated statistically significant differences at p=0.05 or less

3.4.5. Promotional activity by deprivation

Table 40 shows promotions by quintile of deprivation. The two most affluent quintiles have the fewest promotions (21 and 22) whereas the most deprived quintile has the greatest number (34). This greater number of promotions may be a market response to the lower than average incomes of residents of more deprived areas. The most deprived quintile (5) had the largest number of individual food items for which the proportion on promotion was greatest (25 of 35 items) with the next most deprived quintile having the second largest (4 of 35). In the most deprived quintile, six of seven fruit items and six of ten vegetable items, had the greatest proportion on promotion.

Table 40: Promotions by item by deprivation

	Food items	1	2	3	4	5	Chi squared	p value
		Affluent				Deprived		
FRUIT	Frozen berries	0.0	6.3	0.0	0.0	25.0	10.22	0.037
	Oranges	0.0	2.0	4.8	6.8	7.7	3.92	0.417
	Bananas	0.0	2.0	0.0	2.1	6.3	6.23	0.183
	Apples	0.0	0.0	3.1	0.0	4.2	5.03	0.285
	Pineapple	8.1	2.2	1.4	5.5	9.8	6.24	0.182
	Orange juice	2.4	3.6	8.5	1.6	7.9	5.12	0.276
	White grapes	19.2	8.3	2.2	10.5	20.0	8.32	0.081
VEGETABLE	Carrots	0.0	0.0	2.8	0.0	10.0	12.41	0.015
	Red pepper	0.0	0.0	2.0	4.0	10.0	5.99	0.200
	Onions	0.0	0.0	2.7	2.0	5.4	4.83	0.305
	Round lettuce	0.0	2.4	2.2	8.3	6.9	3.66	0.454
	Cucumber	0.0	0.0	2.1	4.6	3.2	2.63	0.621
	Sweetcorn	0.0	0.0	0.0	9.1	0.0	7.44	0.114
	Tomatoes	2.6	0.0	3.0	0.0	4.2	3.38	0.497
	Broccoli	16.7	7.9	11.5	10.5	21.1	2.50	0.645
	Frozen peas	6.5	6.7	3.3	0.0	7.0	3.44	0.487
	baked beans	20.4	39.0	18.8	19.1	31.7	11.17	0.025
CARBOHYDRATE	Spaghetti	2.5	7.1	8.0	15.8	29.0	22.50	<0.001
	Oven chips	17.2	11.6	23.4	26.7	44.0	14.56	0.006
	Wholemeal bread	2.5	0.0	1.3	8.3	12.9	15.78	0.003
	Weetabix	19.1	27.5	18.2	17.2	10.8	5.42	0.247
	Brown rice	0.0	0.0	0.0	0.0	10.0	5.79	0.216
	White rice	6.3	9.1	7.4	8.0	17.0	4.52	0.340
	Potatoes	3.0	0.0	2.7	2.1	5.2	2.86	0.582
	Oats	7.7	17.0	4.1	14.8	10.9	7.01	0.135
	Brown rolls	8.8	1.9	5.1	0.0	9.1	4.76	0.312
MEAL	Birds eye lasagne	27.3	9.7	20.0	12.1	16.7	3.68	0.451
PROTEIN	Lean beef mince	31.8	10.3	15.9	28.6	33.3	7.64	0.106
	Haddock fillets	13.3	0.0	2.4	0.0	20.0	11.54	0.021
	Salmon fillets	23.1	23.1	28.0	33.3	28.6	0.36	0.986
	Chicken breasts	52.4	23.5	24.0	47.1	44.0	9.46	0.051
DAIRY	Low fat spread	0.0	0.0	0.0	0.0	10.3	13.14	0.011
	Low fat yoghurt	23.5	16.0	19.3	27.5	40.4	9.79	0.044
	Semi-skim milk	0.0	1.4	1.2	0.0	5.9	9.24	0.055
	Skimmed milk	0.0	0.0	4.4	0.0	4.8	3.54	0.472

Shaded areas indicated statistically significant differences at p=0.05 or less

3.5. Fresh produce quality

3.5.1. Key points

- Large general food stores have the smallest proportion of fresh fruit and vegetable items rated as poor quality.
- No store type had zero percent of items rated as poor quality.
- Small general stores had the greatest proportion of items rated as poor quality compared to other stores with seven out of the twelve fresh produce items.
- In general deprived sentinels had a greater proportion of their fresh produce rated as poor quality compared to their affluent counterparts.

3.5.2. Quality across all stores

Twelve of the 35 products in the HEISB were fresh produce. Fresh produce quality was assessed on a simple 3 point scale of poor, medium and good[3]. Table 41 shows the proportion of fresh fruit and vegetable items that were of poor quality by sentinel site, Table 42 by shop type and Table 43 by quintile of deprivation.

[3] The fresh produce quality scale is described in full in Appendix 6b.

Table 41: Proportion of fresh produce that was of poor quality by sentinel

Sentinel ID	UR2	UR1	UR3	ST1	ST2	ST2	RD1	RA1	IS2	IS1		
Sentinel environment	Urban D	Urban A	Urban M	Small town D	Small town A	Small town A	Rural D	Rural A	Island M	Island M/D	Chi squared	p value
Onions	26.3	7.7	2.9	0.0	16.7	0.0	0.0	2.9	0.0	5.0	71.80	<0.001
Potatoes	6.4	22.2	6.1	0.0	0.0	0.0	0.0	0.0	0.0	5.4	61.41	<0.001
Bananas	16.3	10.0	14.7	0.0	20.0	20.0	7.7	0.0	6.9	16.7	57.15	<0.001
Apples	16.7	0.0	20.0	0.0	0.0	16.7	0.0	0.0	0.0	7.7	55.02	<0.001
Tomatoes	16.0	0.0	29.6	0.0	80.0	25.0	7.1	6.7	7.4	23.3	47.74	<0.001
Oranges	5.0	0.0	10.0	0.0	16.7	0.0	21.4	3.1	0.0	5.7	42.68	0.001
Round lettuce	26.1	0.0	10.0	0.0	25.0	0.0	0.0	0.0	25.0	6.3	29.75	0.040
Carrots	14.3	10.0	6.9	0.0	0.0	33.3	13.3	3.1	0.0	10.5	27.64	0.068
Cucumber	7.4	0.0	5.6	0.0	20.0	0.0	0.0	5.0	0.0	0.0	23.30	0.179
Broccoli	5.9	20.0	11.8	0.0	0.0	0.0	8.3	0.0	6.3	0.0	21.28	0.265
Red pepper	5.3	0.0	22.2	0.0	33.3	0.0	8.3	5.3	12.5	18.2	17.64	0.480
White grapes	3.5	0.0	6.3	0.0	0.0	0.0	0.0	5.3	0.0	5.9	15.38	0.636

D=deprived; M=mixed; A=affluent; Shaded areas indicated statistically significant differences at p=0.05 or less

Table 41 shows that in general the deprived analogues of each sentinel environmental setting had a greater proportion of their fresh produce rated as poor quality except for small town settings where the majority of poor quality items were found in the affluent analogue. For seven of the twelve fresh items there was a significant difference in the proportion of items rated as poor quality across the nine sentinel sites. However there were no consistent patterns by each individual food item.

Table 42 shows that large general food stores had the smallest proportion of fresh fruit and vegetable items rated as poor quality (2 out of 12) and the greatest number of individual items that were never rated as being of poor quality (9 out of 12). Small general stores fared the worst having the greatest proportion of items rated as poor quality compared to other stores for seven of the twelve items. No store type had zero percent of its items being of poor quality.

Table 42: Proportion of fresh produce that was of poor quality by store type

Food items	Large general	Medium general	Small General	Specialist	Food secondary	Chi squared	p value
Potatoes	7.7	0.0	4.0	2.7	66.7	39.37	<0.001
Bananas	15.4	7.1	12.0	4.8	50.0	24.78	0.002
Onions	0.0	0.0	11.2	2.4	25.0	24.17	0.002
Apples	7.7	0.0	9.8	3.3	50.0	23.58	0.003
Red pepper	0.0	4.6	15.7	10.0	-	11.04	0.087
Oranges	0.0	0.0	7.6	3.5	0.0	10.73	0.218
Carrots	0.0	0.0	11.7	0.0	-	10.49	0.106
Tomatoes	0.0	13.8	19.3	5.7	0.0	10.13	0.256
Round lettuce	0.0	0.0	16.5	6.7	-	9.84	0.132
Cucumber	0.0	4.2	3.8	5.9	-	8.08	0.233
White grapes	0.0	0.0	4.1	5.9	-	6.23	0.398
Broccoli	0.0	3.7	8.2	0.0	-	4.30	0.635

Shaded areas indicated statistically significant differences at p=0.05 or less

Table 43 shows that by quintile of deprivation there was no consistent pattern of poor quality, though apples, onions, carrots and round lettuce all had the highest proportions of items being of poor quality in the most deprived quintile.

Table 43: Proportion of fresh produce that was of poor quality by deprivation

Food items	1 (affluent)	2	3	4	5 (deprived)	F statistic	p value
Apples	2.8	4.1	8.1	11.6	12.8	20.94	0.007
Potatoes	3.7	2.4	1.5	9.5	5.6	18.62	0.017
Oranges	3.3	2.0	12.1	5.3	2.8	17.93	0.022
Cucumber	13.6	0.0	2.5	0.0	3.7	17.46	0.026
Onions	5.6	2.0	8.5	7.0	17.0	16.90	0.031
Bananas	3.3	13.3	12.3	15.8	10.9	15.42	0.051
Carrots	8.6	0.0	7.9	9.1	13.9	14.55	0.068
Broccoli	4.4	3.6	0.0	21.4	5.6	13.19	0.106
Tomatoes	11.4	6.8	19.0	22.2	15.6	12.38	0.135
Round lettuce	13.6	6.1	8.8	11.8	18.2	7.63	0.470
White grapes	4.4	0.0	5.6	0.0	3.7	7.42	0.492
Red pepper	11.8	9.1	10.5	16.7	10.5	6.15	0.631

Shaded areas indicated statistically significant differences at p=0.05 or less

3.6. Opening hours

3.6.1. Key points

- Urban mixed areas had the longest opening hours and island mixed/deprived the shortest.
- Opening hours were positively correlated with deprivation and amount of the HEISB stocked.

3.6.2. Opening hours across all stores

Tables 44-46 show weekly store opening hours by site, by shop type and by deprivation. Mobile stores, home deliverers and those recorded with 0 weekly hours were excluded from this analysis (n=17). Overall the 449 shops were open a median 76 hours per week.

In the three tables below median opening hours are compared across categories using Kruskal Wallis test. There is significant variation in median opening hours across sentinel sites (p=0.0001), shop type (p=0.0001) and quintiles of deprivation (p=0.0002). Urban mixed areas had the longest median opening hours (96 hours per week) and island mixed/deprived the shortest. Large general stores were open for the longest (93 hours per week) followed by small general (87.5 hours) and food secondary (86 hours) with specialist stores open the shortest amount of time (51 hours per week). Stores located in the two most deprived quintiles stayed open the longest (78.75 and 80.50 hours) whereas stores in quintile 3 stayed open the least hours per week (63.5 hours). Weekly opening hours were positively correlated with deprivation score (r=0.109, p=0.019) and number of food items (out of 35) available in each store (r=0.23, p<0.000).

Table 44: Variation in opening hours by site

N (shops)	Mean	SD	Median	IQ range
449	75.27	28.33	76	54.00-93.00

SITE

Sentinel site	*n*	*Mean*	*SD*	*Min*	*Max*	*Median*	*IQ range*
Island M/D	55	60.45	15.42	36	108.00	57	51.00-72.00
Island D	40	64.16	19.22	10	98	62.75	50.50-78.38
Rural A	58	64.01	31.41	4	125.88	65.13	45.50 -93.00
Rural D	20	74.98	17.88	41.00	94.00	80.25	61.50-90.00
Small Town D	31	72.41	23.26	24	105.00	77	52.50-94.00
Small Town A	13	68.11	22.89	40	105.00	71	44.00-86.00
Small Town A	9	84.89	24.50	43.00	118.00	83.00	64.50-104.00
Urban A	38	76.91	22.61	31.00	119.00	73.75	57.00-96.00
Urban D	115	83.81	30.28	7.50	167.88	82.00	63.00-95.50
Urban M	70	89.12	32.12	29.50	167.77	96.00	62.50-104.00

Kruskal-Wallis test	Chi squared = 61.00	p=0.0001

Table 45: Variation in opening hours by shop type

N (shops)	Mean	SD	Median	IQ range
449	75.27	28.33	76	54.00-93.00

SHOP TYPE

Shop Type	*n*	*Mean*	*SD*	*Minimum*	*Maximum*	*Median*	*IQ range*
Large general	13	100.57	32.93	55.00	167.77	93.00	84.00-101.00
Medium general	29	76.64	11.76	56.50	98.00	78.50	66.50-81.00
Small general	265	85.88	25.92	22	167.83	87.5	70.00-101.00
Specialist	127	48.76	16.04	4	87.50	51.00	43.00-58.00
Food secondary	15	87.75	14.72	66.75	112.00	86.00	77.00-104.00

Kruskal-Wallis test	Chi squared = 189.62	p=0.0001

Table 46: Variation in opening hours by deprivation

N (shops)	Mean	SD	Median	IQ range
449	75.27	28.33	76	54.00-93.00

DEPRIVATION

Level of Deprivation	*n*	*Mean*	*SD*	*Minimum*	*Maximum*	*Median*	*IQ range*
1 (affluent)	63	79.88	29.74	4	125.88	89	56.50-104.00
2	90	73.16	28.05	6	167.88	72.00	52.50-89.00
3	117	66.61	23.25	4	112.00	63.50	48.50-84.00
4	67	80.34	25.42	31	167.88	80.50	59.00-95.00
5 (deprived)	112	80.39	32.07	7.50	167.88	78.75	58.75-95.75

Kruskal-Wallis test	Chi squared = 22.00	p=0.0002

3.7. Disabled access

Each store was given an assessment by the surveyor as to the disabled access for a wheelchair user. The assessment could be None, Some or Full (see Appendix 6b for detailed surveyor instructions). Table 47 summarises the levels of access found across all store types.

Table 47: Disabled access by type of store

Store type	None	%	Some	%	Full	%	Valid total	no data	%	Total
Large	0	0	0	0	12	100	12	1	8	13
Medium	1	4	3	11	23	85	27	2	7	29
Small	93	36	98	38	68	26	259	9	3	268
Specialist	24	19	32	25	70	56	126	15	11	141
Secondary	5	33	5	33	5	33	15	0	0	15
Total	123	28	138	31	178	41	439	27	6	466

It can be seen that 100% of the Large stores and 85% of the Medium stores surveyed had Full access, whereas only 26% of Small stores and 56% of Specialist stores had Full access.

Data were not collected on 6% of the 466 stores surveyed - either as they were a mobile operation or not collected for some other reason.

The sentinels with the highest level of 'Full' access across all store types, both with 61%, were the rural and urban affluent sentinels. The sentinels with the lowest level of 'Full' access were rural deprived with none, island mixed with 28% and small town affluent with 29%.

3.8. Sentinel maps

This section described the maps of the sentinels produced from the survey data. Copies of all the sentinel maps may be found in the map appendix – appendix 13.

There are nine sentinels consisting of one or more distinct areas. All the parts of a sentinel have been shown on the same map picture layout, at the same scale. Because the sentinels vary considerably in size three different scales have had to be used to facilitate comparisons. Table 48 describes the set of maps and the scale used.

Table 48: Map scales used

	Rurality	**Deprivation**	**Scale**
IS1	Island: small town/rural	Mixed, deprived.	1:450,000
IS2	Island: small town/rural	Mixed.	1:450,000
RA1	Rural, small town	Affluent	1:150,000
RD1	Rural	Deprived	1:450,000
ST1	Small town	Deprived	1:40,000
ST2	Small town	Affluent	1:40,000
UR1	Urban (large)	Affluent	1:40,000
UR2	Urban (large)	Deprived	1:40,000
UR3	Urban (other)	Mixed	1:40,000

Because some of the sentinels are geographically dispersed some of the maps show different parts of a sentinel in different boxes. These specific cases are:

1. In IS1 the left-hand box, IS1n, shows the northern half of Eilean Siar, i.e. Lewis and Harris. The right-hand box, IS1s, shows the islands in the southern half of Eilean Siar. From north to south these are Berneray, North Uist, Benbecula, South Uist, Eriskay and Barra.
2. In ST1 the top box shows Kilbirnie and Beith. The lower left box shows Dalry and the lower right box shows Lochwinnoch.
3. In ST2 the lower left box, ST2c, shows Cupar and the upper right box, ST2e, shows Ellon.

Fifteen different sets of nine sentinel maps have been produced to illustrate different aspects of the results, giving 135 maps in all.

3.8.1. Set 1: Population and food retail type

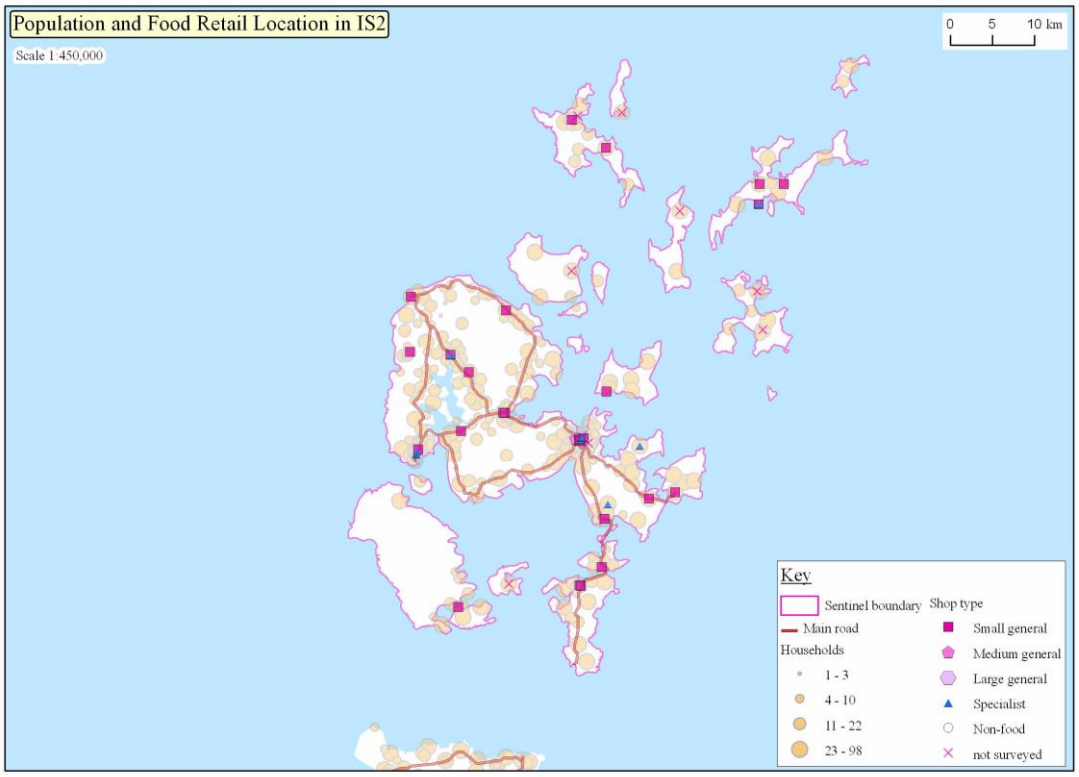
The domestic population density in the sentinel area is illustrated used varying sizes of beige circle. Each circle represents a postcode with a number of households associated with it. The circles vary in size according to the number of households.

This representation scheme was chosen to best illustrate the very heterogenous nature of Scotland's housing density, at the varying map scales being used. Population density in the sentinels being surveyed varied from 0 households per square kilometre to over 8,500, i.e. almost 5 orders of magnitude.

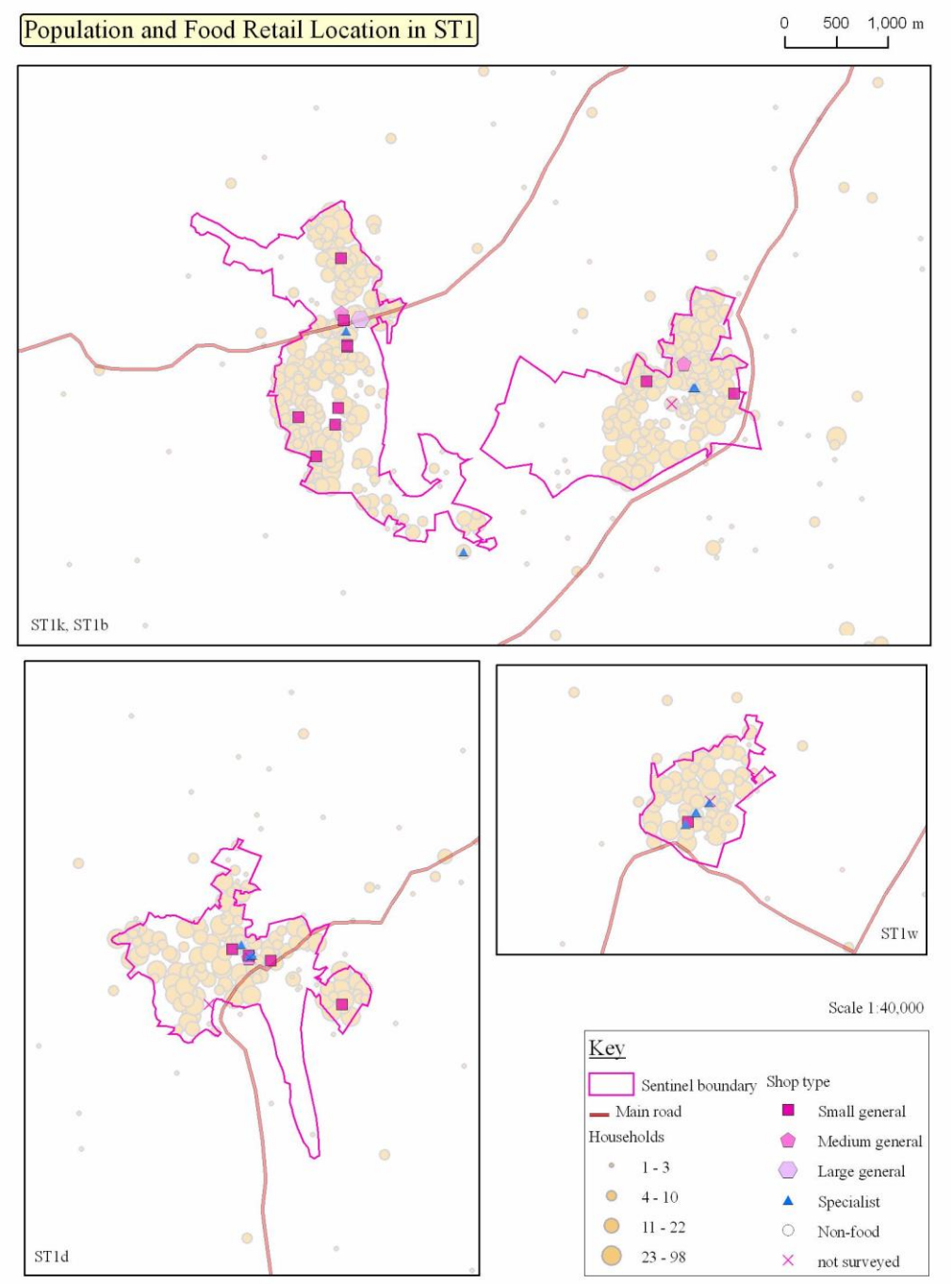
The type of food retail store surveyed has been shown using a pink-blue colour scale and geometric shape configuration. This symbology was chosen to avoid any high/low implications. Table 49 below specifies the store type symbology. The main roads[4] are also shown.

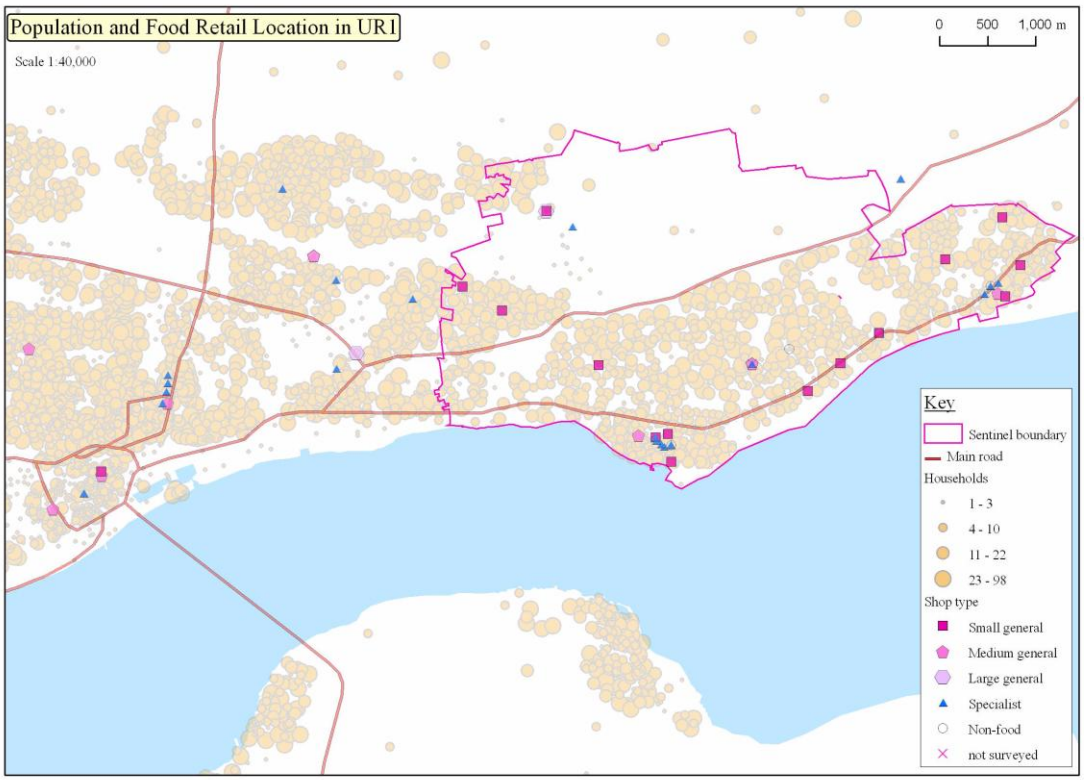
Table 49: Store type map symbology

Store type	Colour	Shape
Small general	Dark pink	square
Medium general	Light pink	pentagon
Large general	Lilac	hexagon
Specialist	Blue	triangle
Non-food	empty	circle
Not surveyed	Pink	cross



[4] Main roads are defined as Prime roads (A and M) from the Ordnance Survey 1:250 000 scale Strategic data product supplied through the EDINA Digimap service.


Population and Food Retail Location in ST1
0 500 1,000 m
ST1k, ST1b
ST1w
ST1d
Scale 1:40,000
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
Shop type
Small general
Medium general
Large general
Specialist
Non-food
not surveyed



3.8.2. Set 2: HEISB availability

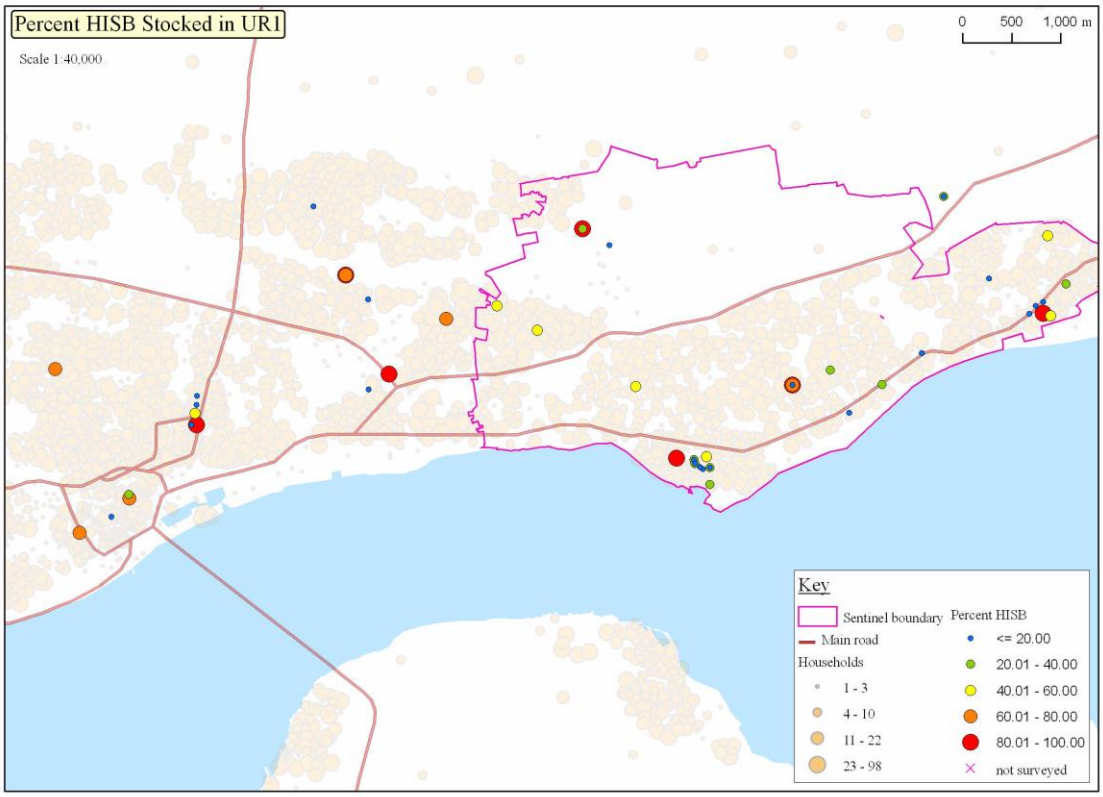
The percentage availability of the overall HEISB, at the food shops surveyed, is shown in the second set of maps. The household population symbols have been kept, at a lower visibility, for reference purposes.

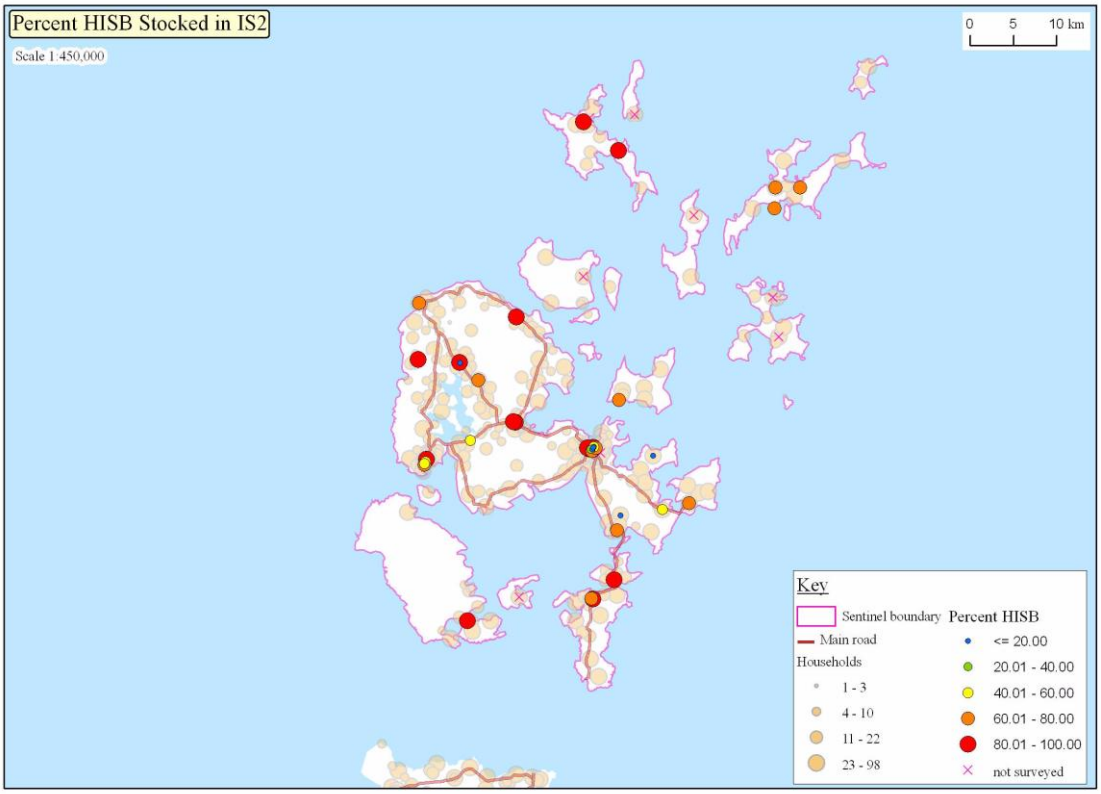
Table 50 specifies the HEISB availability symbology. This symbology was specifically developed to avoid confusion with the store type symbology.

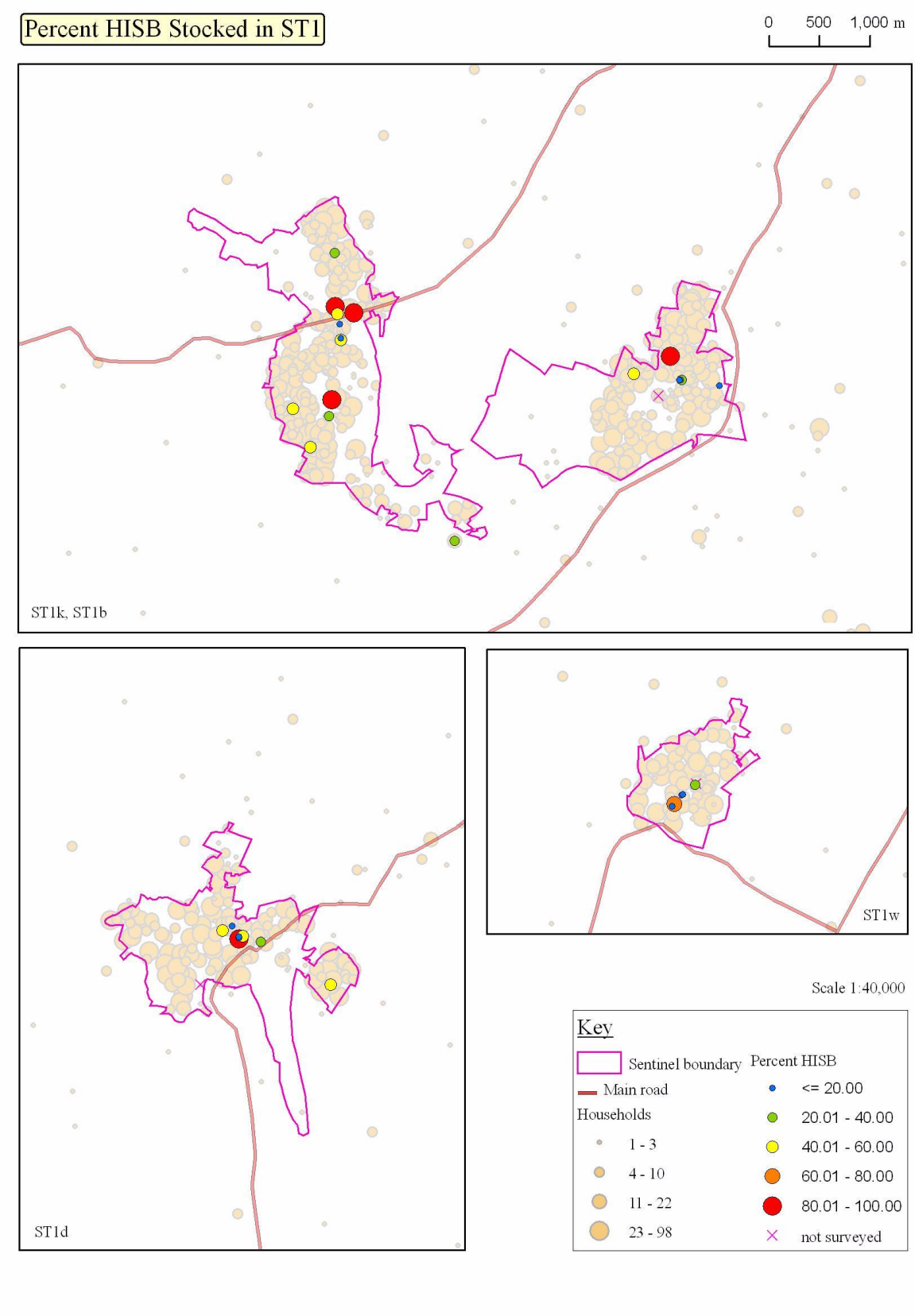
Table 50: HEISB availability symbology

Symbol	HEISB availability
	Less than 20%
	20% to 40%
	40% to 60%
	60% to 80%
	80% to 100%

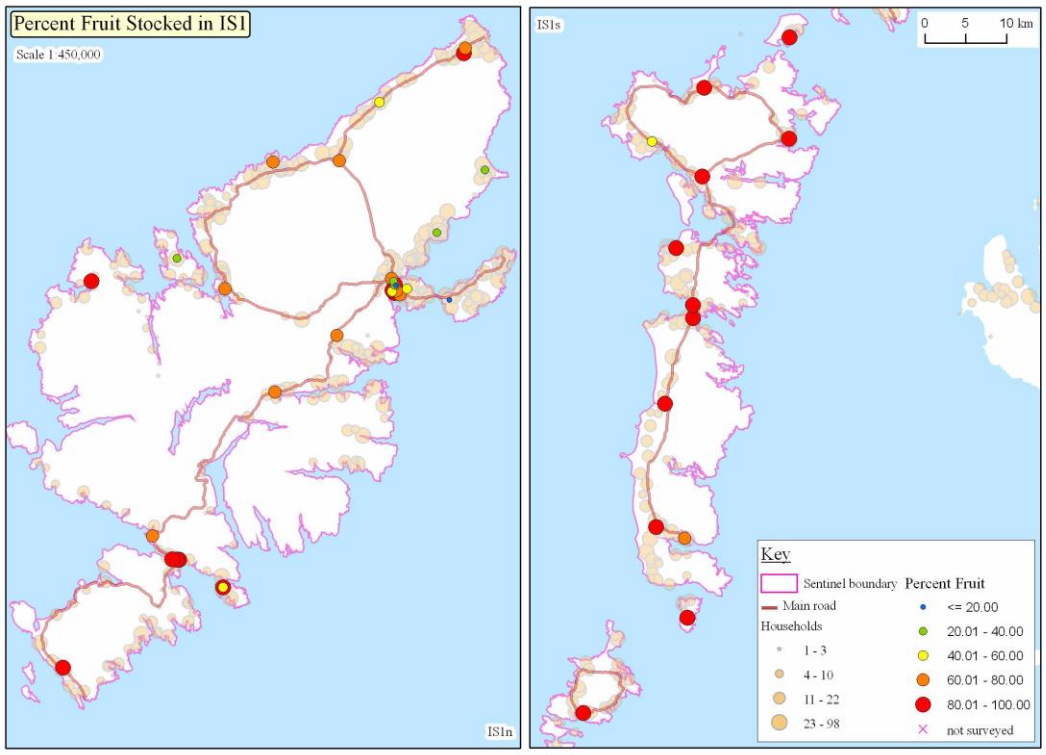
The HEISB symbols are plotted so that the smaller ones are on top of the larger ones. This enables the variety, and extent, of choice in an area to be seen. Sets 3 fruit, 4 vegetable and 5 carbohydrate use exactly the same symbology as the overall HEISB.

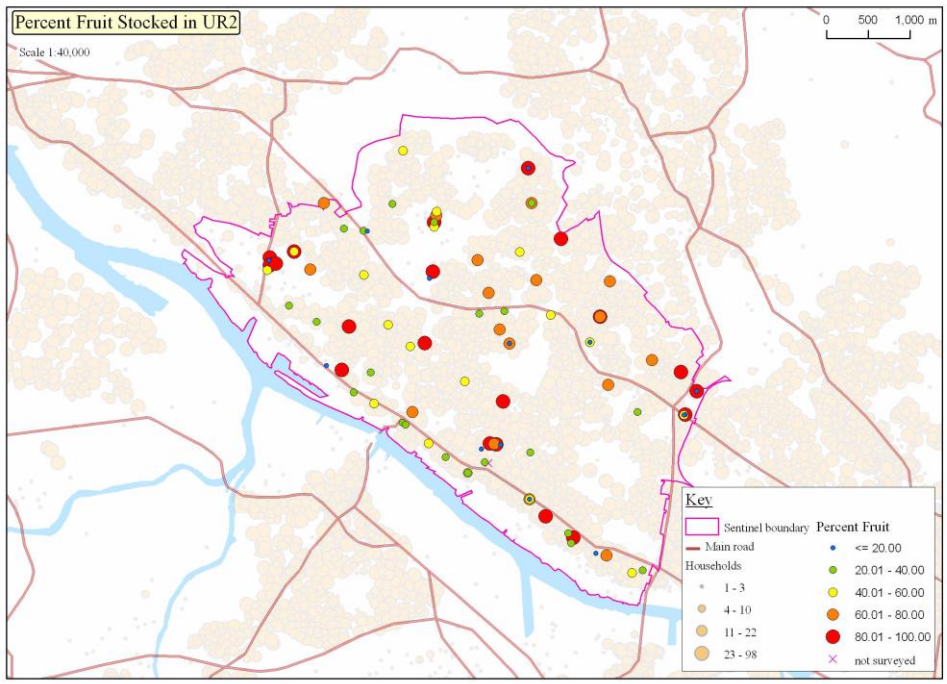

Percent HISB Stocked in UR1
Scale 1:40,000
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
Percent HISB
<= 20.00
20.01 - 40.00
40.01 - 60.00
60.01 - 80.00
80.01 - 100.00
not surveyed


Percent HISB Stocked in IS2
Scale 1:450,000
0 5 10 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
Percent HISB
<= 20.00
20.01 - 40.00
40.01 - 60.00
60.01 - 80.00
80.01 - 100.00
not surveyed

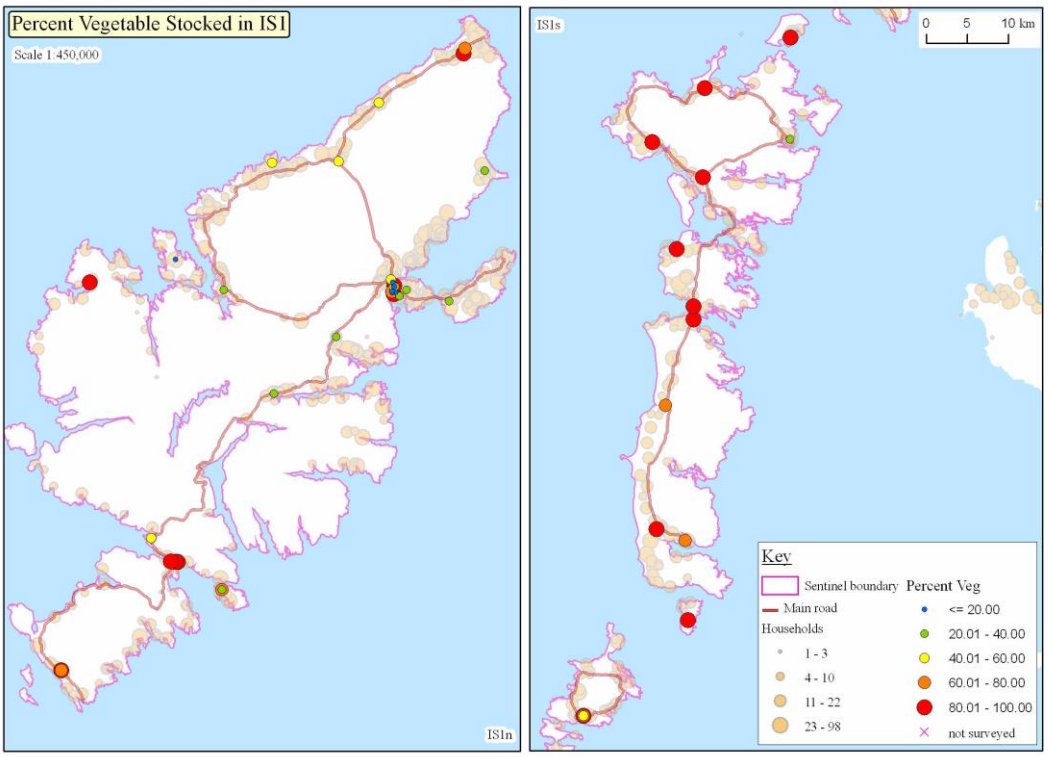

Percent HISB Stocked in ST1
0 500 1,000 m
ST1k, ST1b
ST1d
ST1w
Scale 1:40,000
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
Percent HISB
<= 20.00
20.01 - 40.00
40.01 - 60.00
60.01 - 80.00
80.01 - 100.00
not surveyed

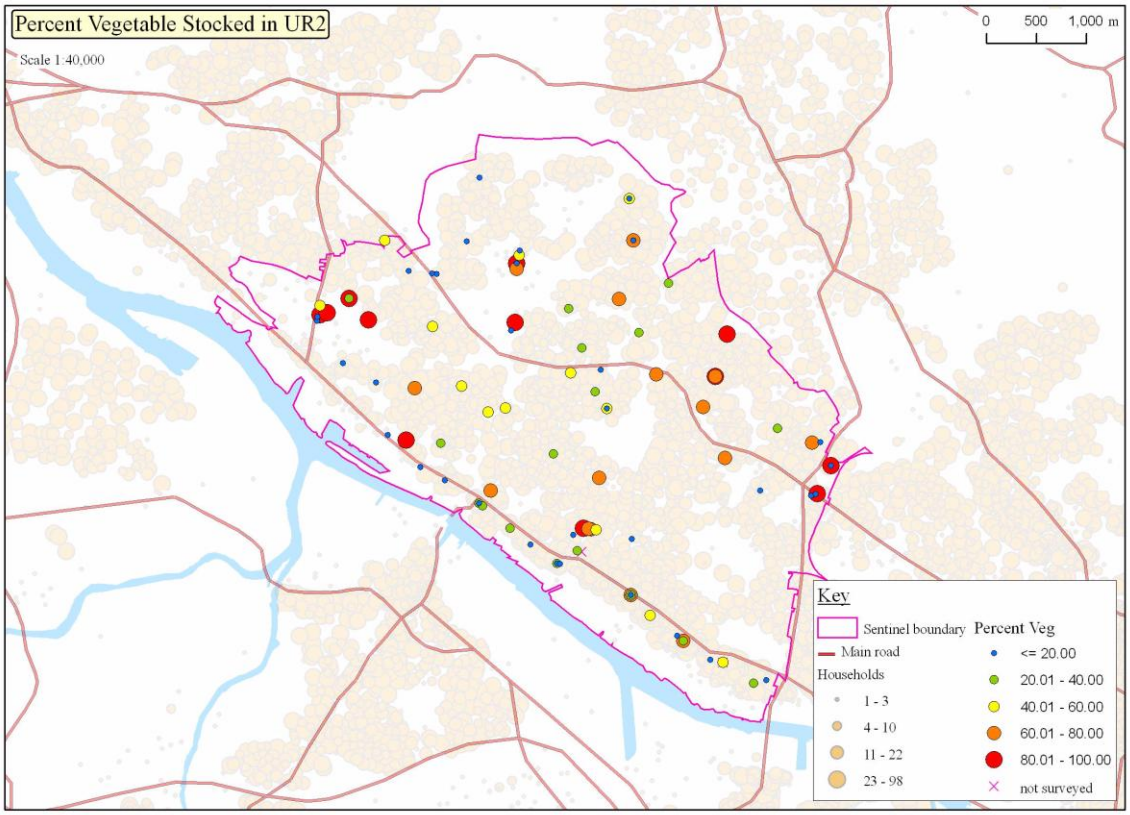
3.8.3. Set 3: Fruit food group availability



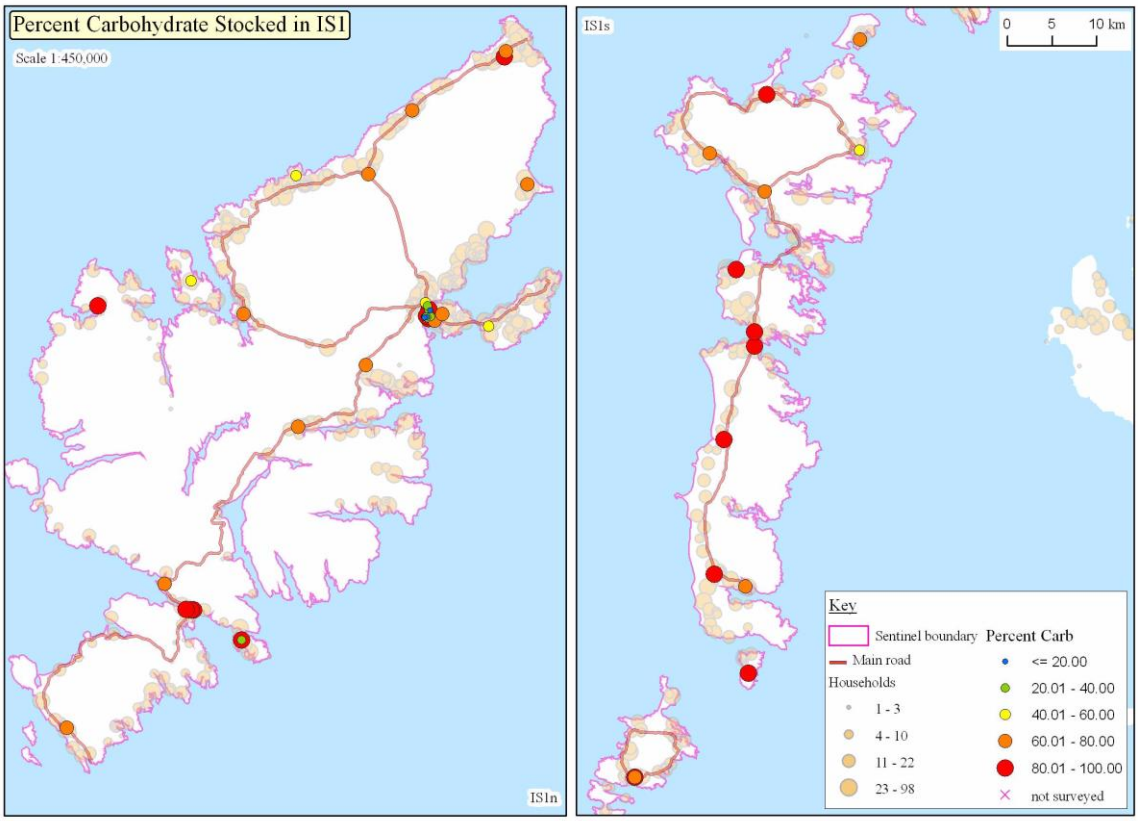


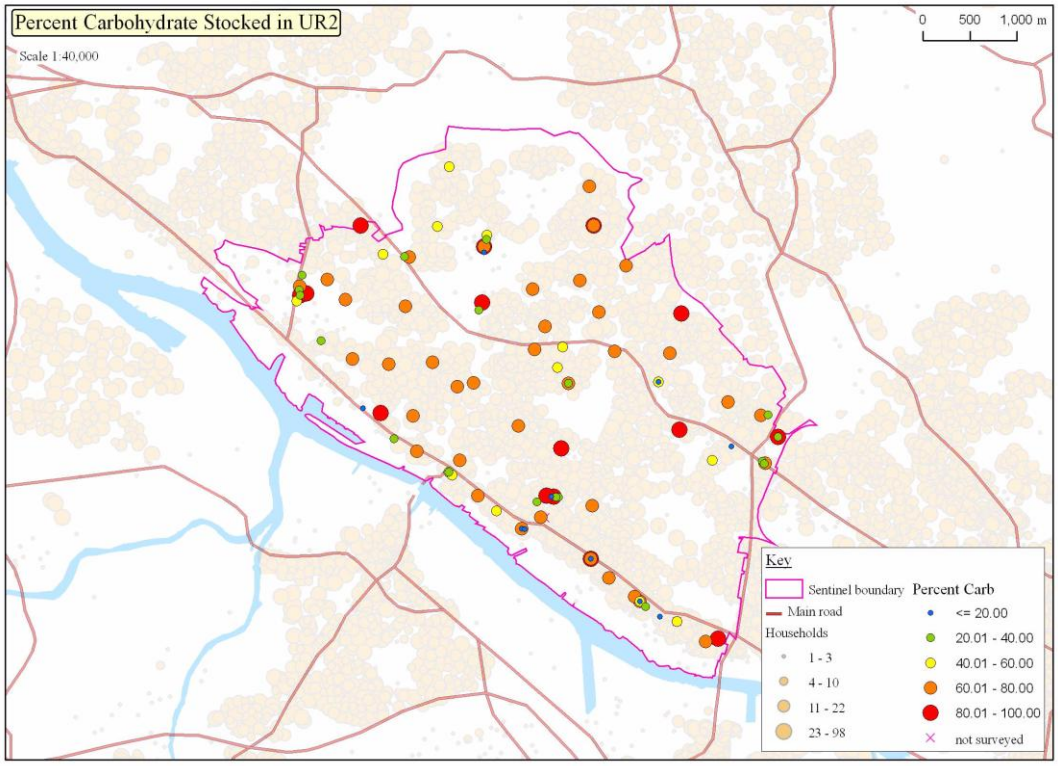
3.8.4. Set 4: Vegetable food group availability





3.8.5. Set 5: Carbohydrate food group availability



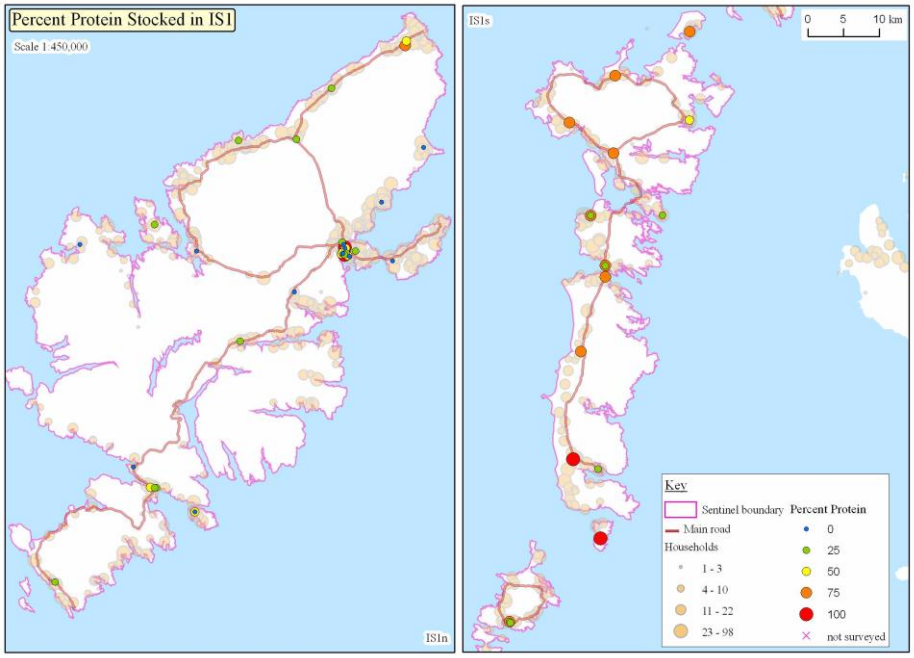


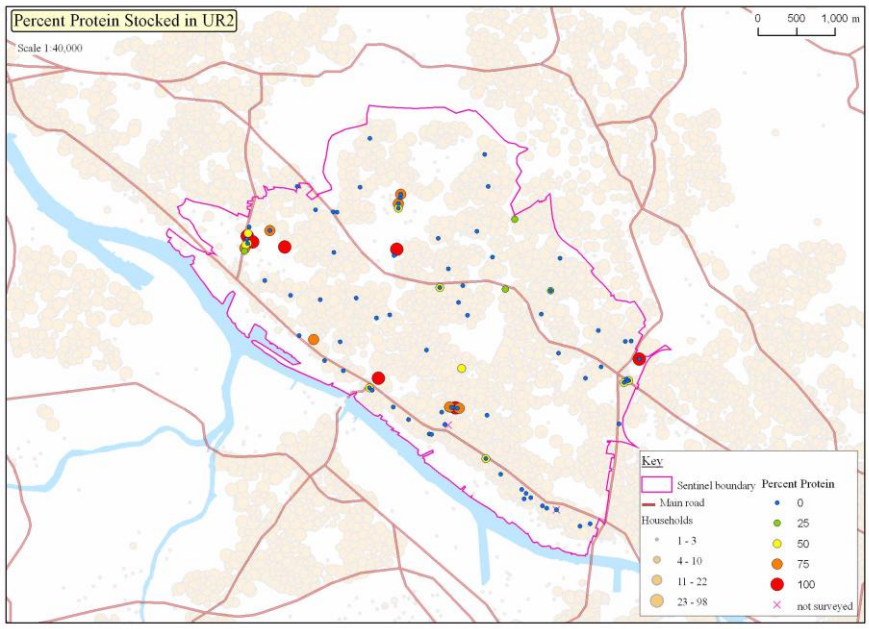
3.8.6. Set 6: Protein food group availability

Sets 6 protein and 7 dairy use a modified symbology as there were only four foods in each group, as shown in the table 51.

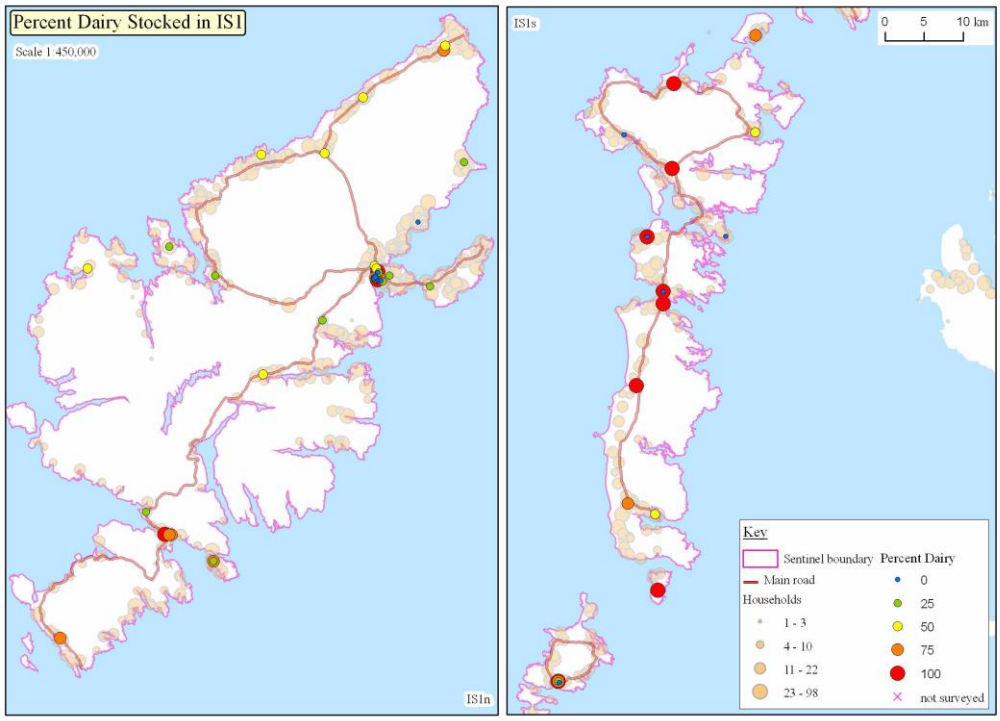
Table 51: Protein/dairy availability symbology

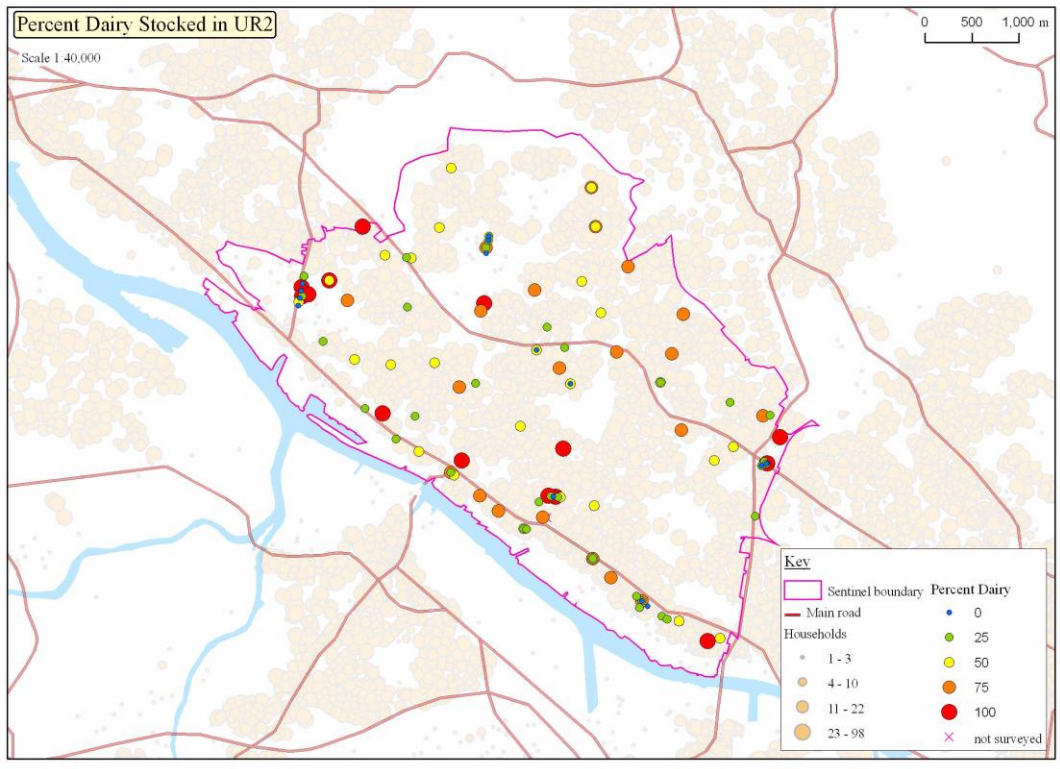
Symbol	Food group availability
	None, i.e. 0%.
	1 out of 4, i.e. 25%
	2 out of 4, i.e. 50%
	3 out of 4, i.e. 75%
	4 out of 4, i.e. 100%





3.8.7. Set 7: Dairy food group availability





3.8.8. Product price variation - Apples and Semi-skimmed milk

The variation in the price of Apples and Semi-skimmed across all the sentinels are shown in these maps. Other maps are available on request. The product price range maps available are shown in Table 52 below. Product food group has been shown for confirmation and to allow a degree of comparison at a food group level. Complete comparison at the food group level is not possible as not all shops stock all members of a food group.

Table 52: Product price variation maps

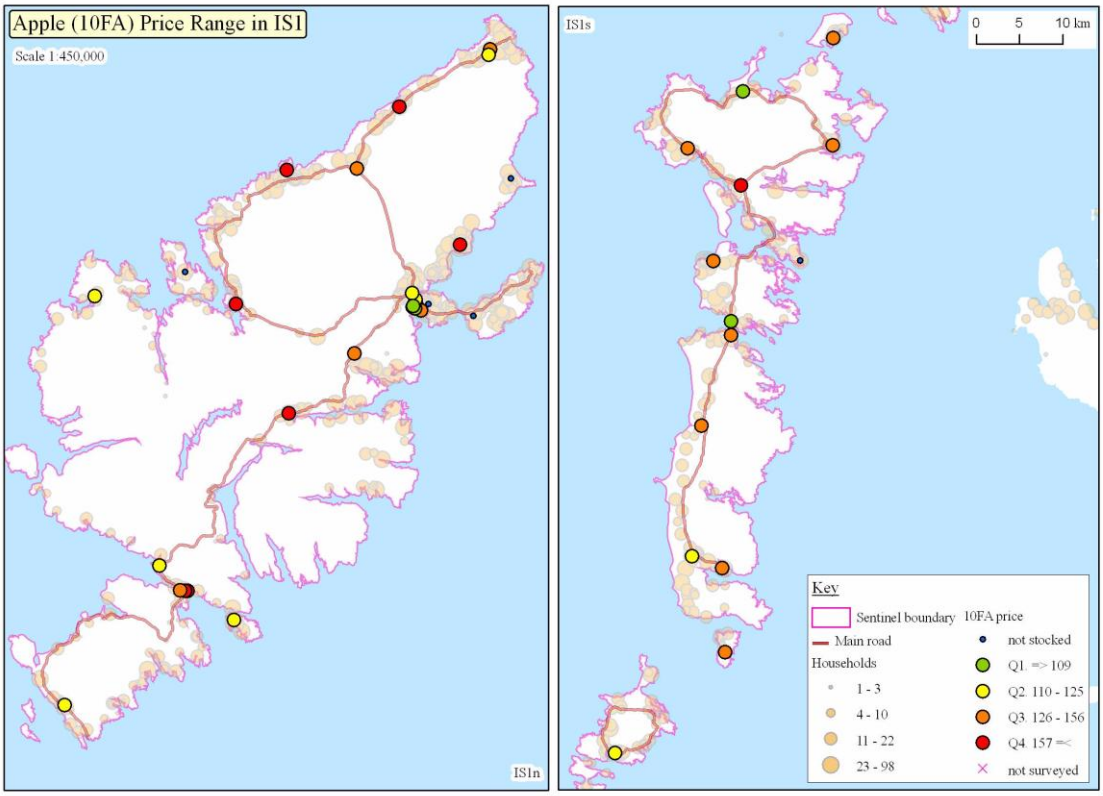
Set	Product	Food group
8	Apples	Fruit
9	Onions	Vegetable
10	Rice (brown)	Carbohydrate
11	Sweetcorn (low salt/sugar)	Vegetable
12	Berries (frozen)	Fruit
13	Lasagne (frozen)	Meal
14	Milk (semi-skimmed)	Dairy

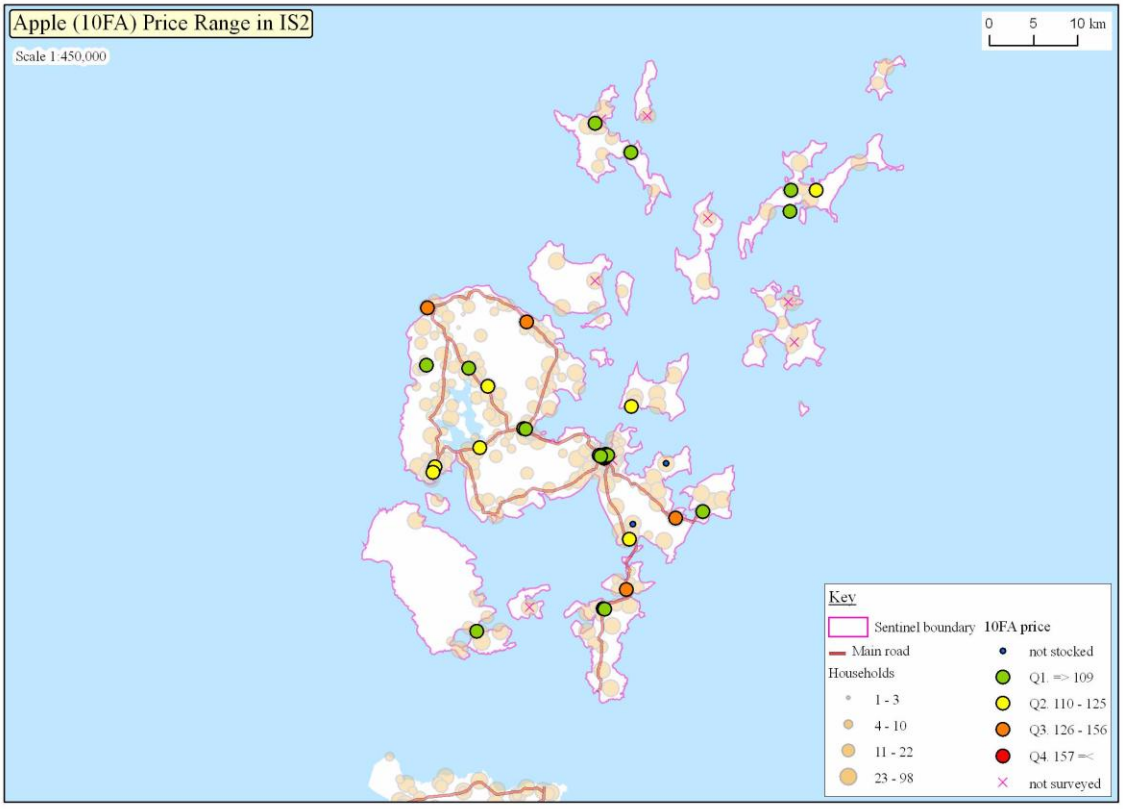
Each set of maps shows the quartiles of the product price range across all sentinel stores. Only price data from sentinel stores has been used. However where there are buffer stores within the extent of the maps these are shown, using their price data, but according to the all sentinel price range.

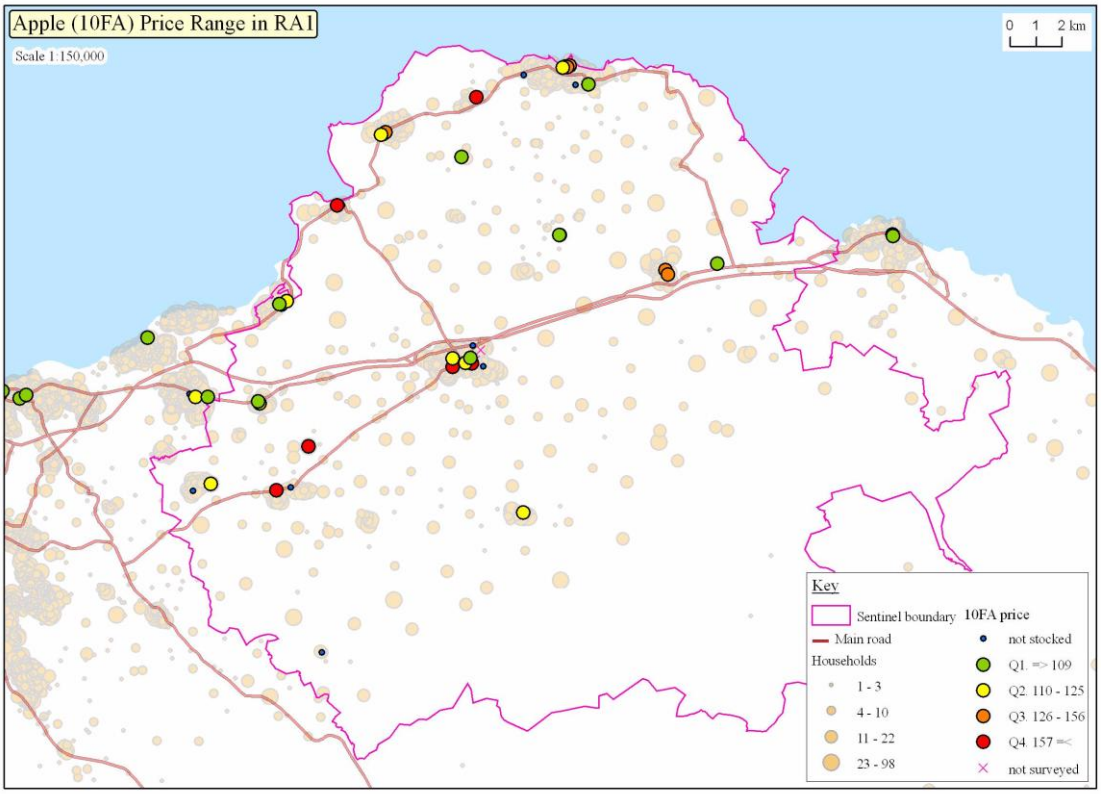
The symbology used to illustrate the range in product prices is shown in Table 53. When these symbols are plotted the cheapest is plotted on top to allow the best price available to be shown.

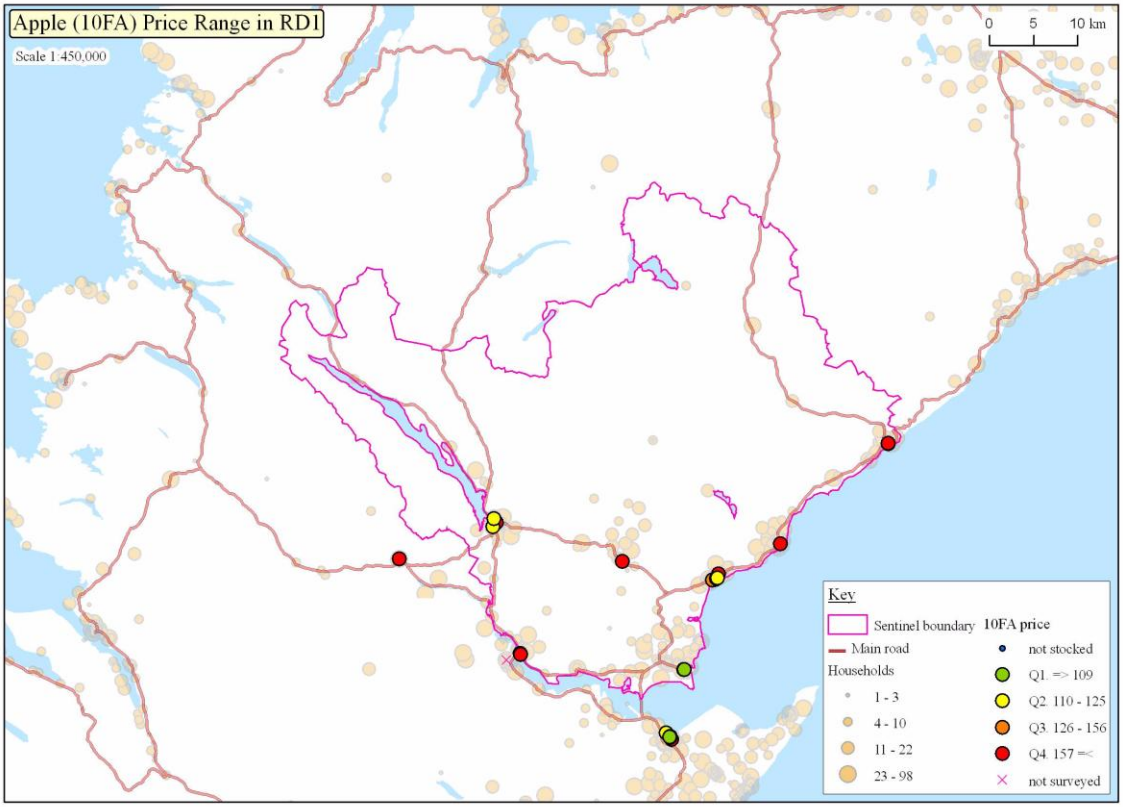
Table 53: Product price variation symbology

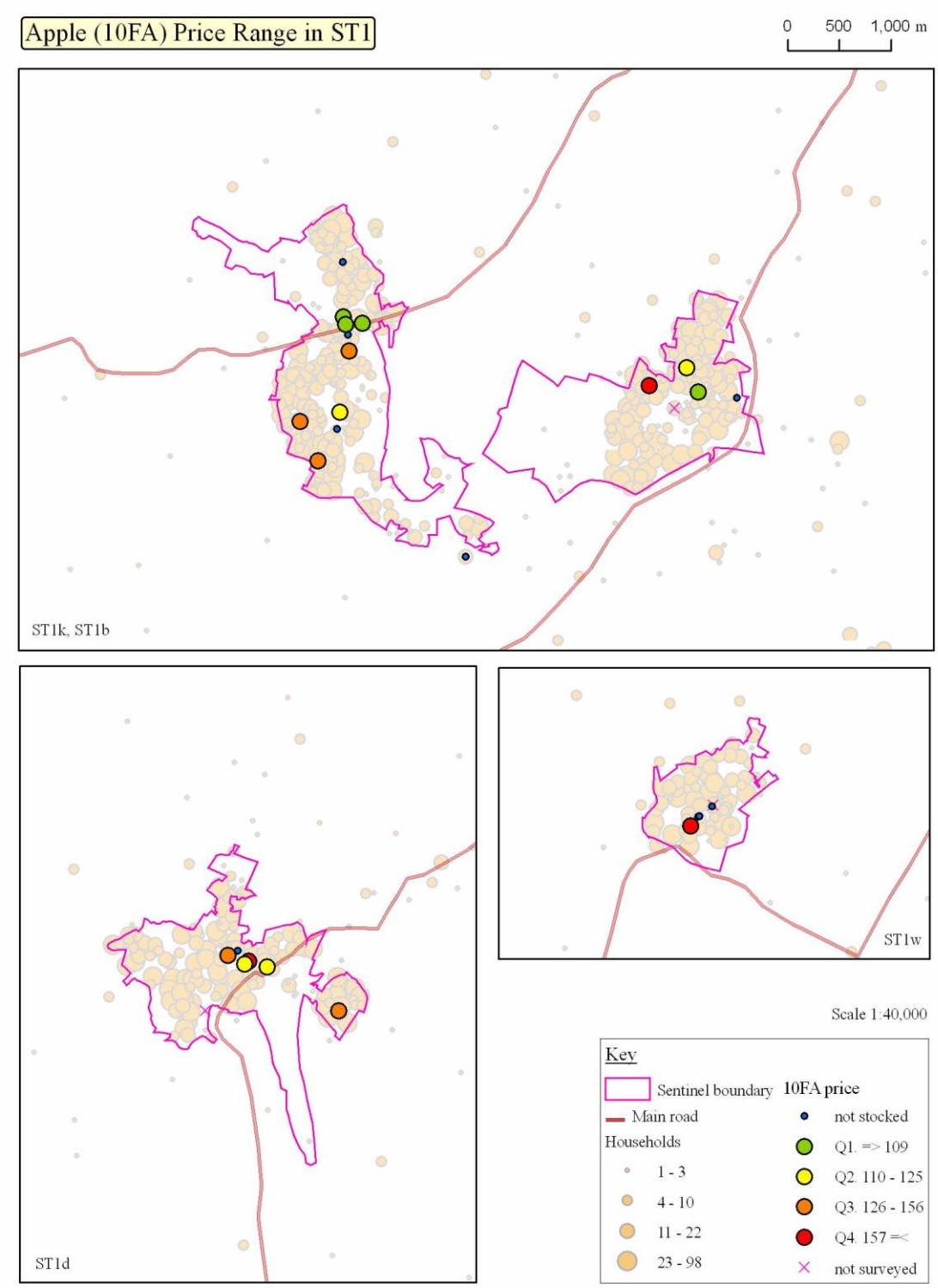
Symbol	Product price range
	Not stocked
	1st quartile
	2nd quartile
	3rd quartile
	4th quartile
D	Not surveyed

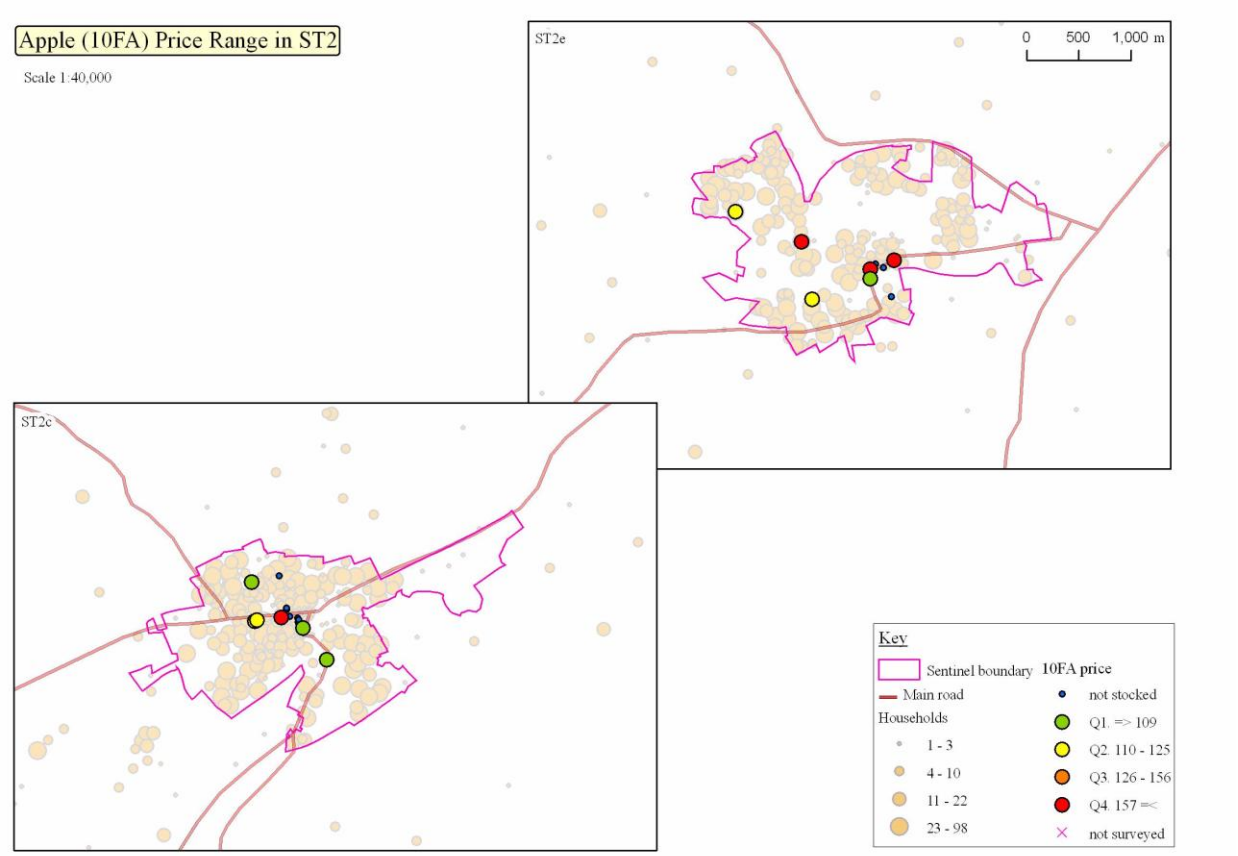

Apple (10FA) Price Range in IS1
Scale 1:450,000
IS1n
IS1s
0 5 10 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

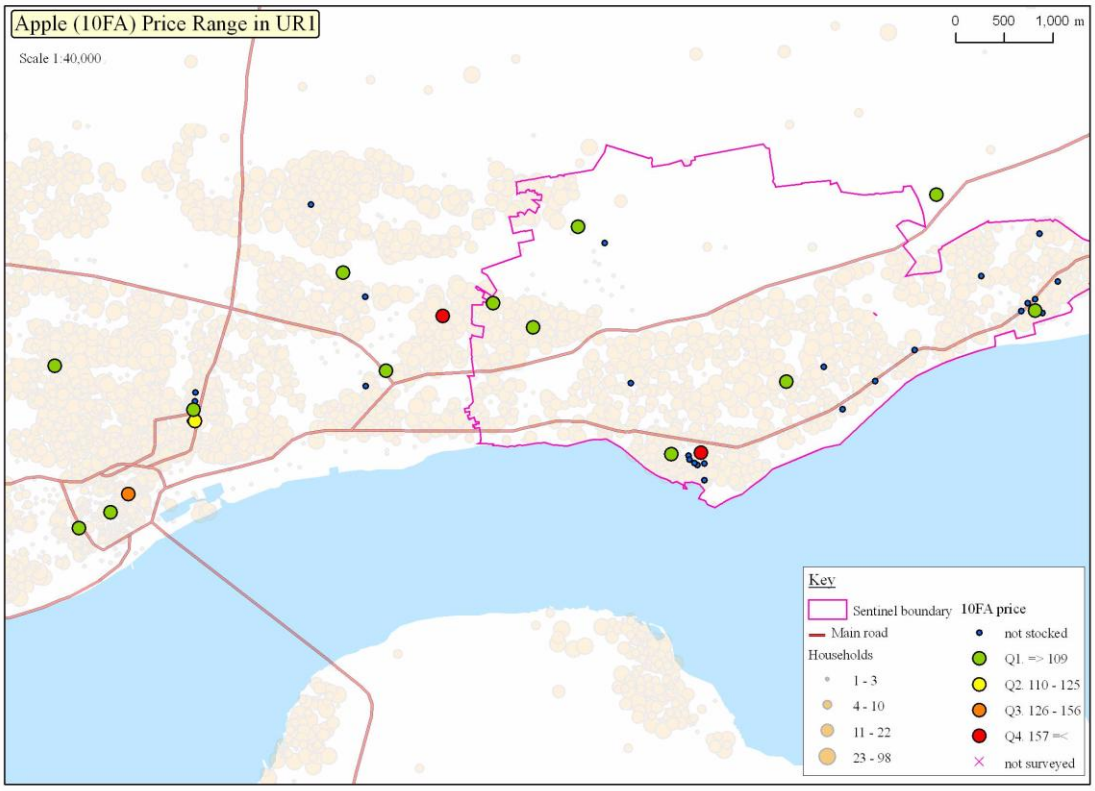

Apple (10FA) Price Range in IS2
Scale 1:450,000
0 5 10 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

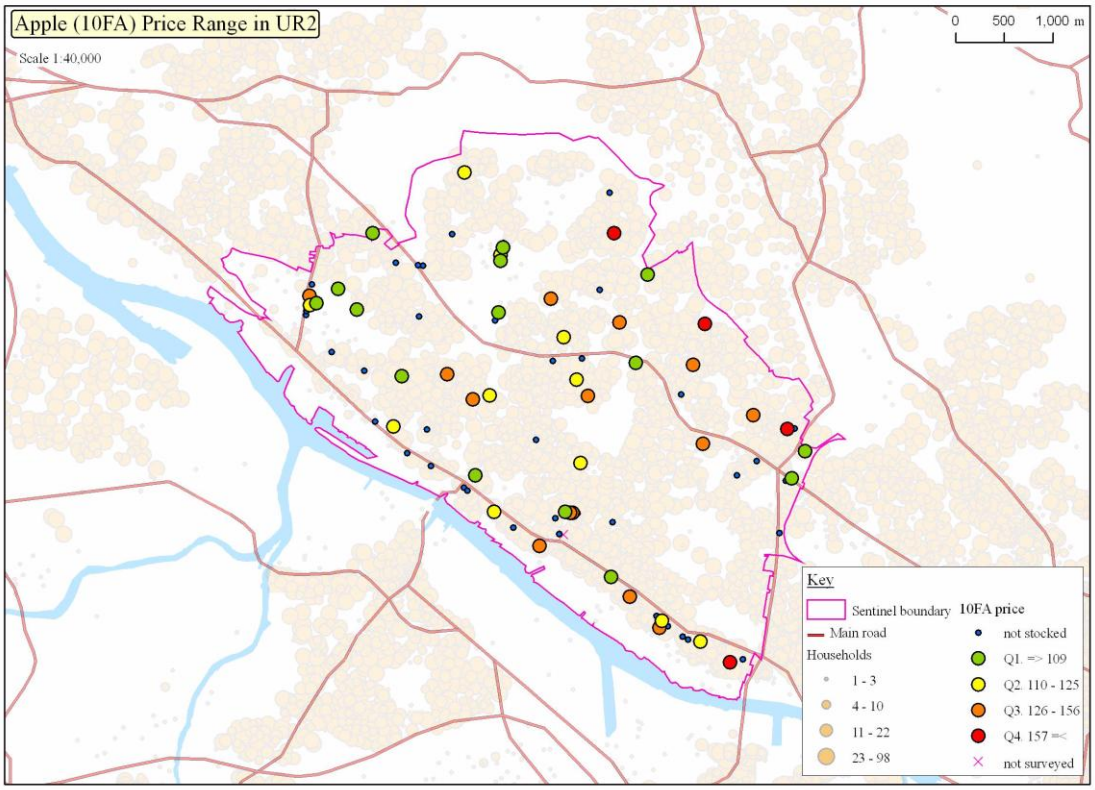

Apple (10FA) Price Range in RA1
Scale 1:150,000
0 1 2 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

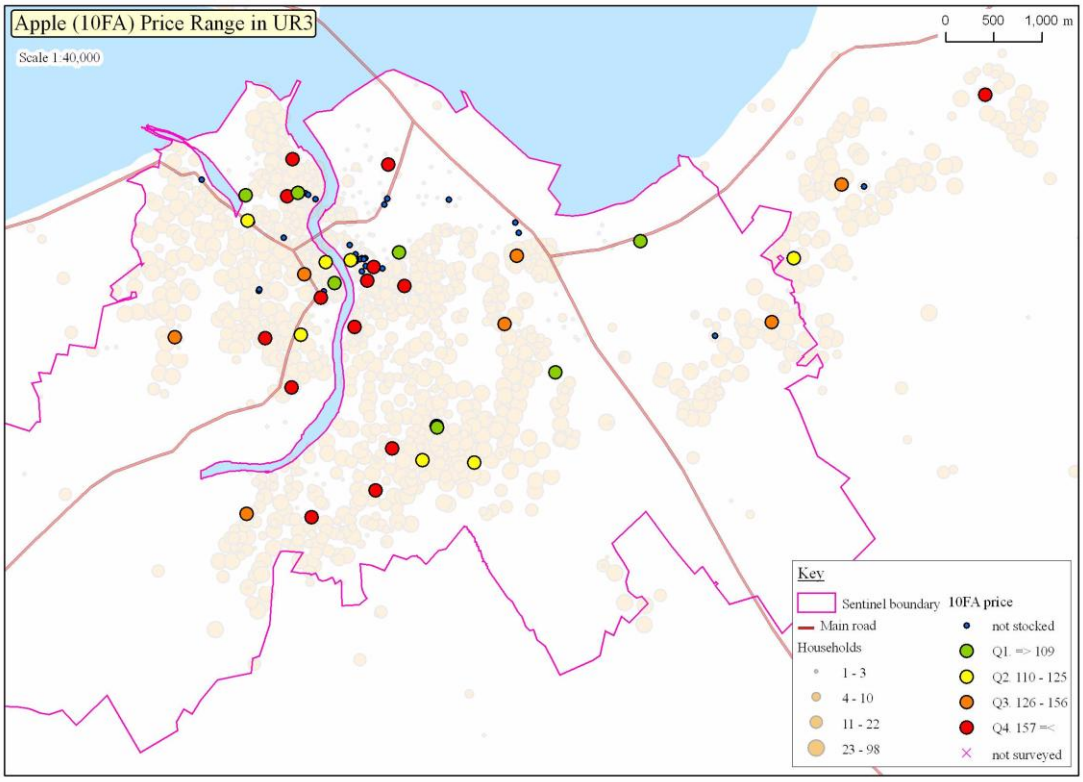

Apple (10FA) Price Range in RD1
Scale 1:450,000
0 5 10 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

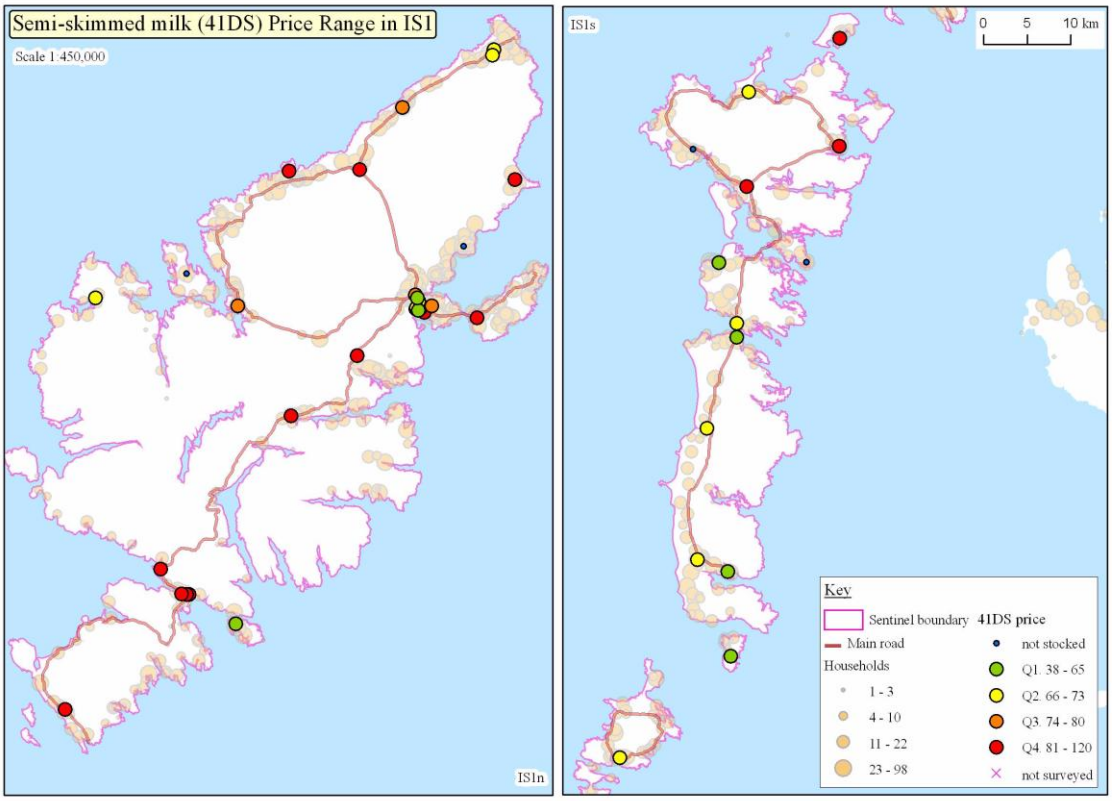

Apple (10FA) Price Range in ST1
0 500 1,000 m
ST1k, ST1b
ST1d
ST1w
Scale 1:40,000
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

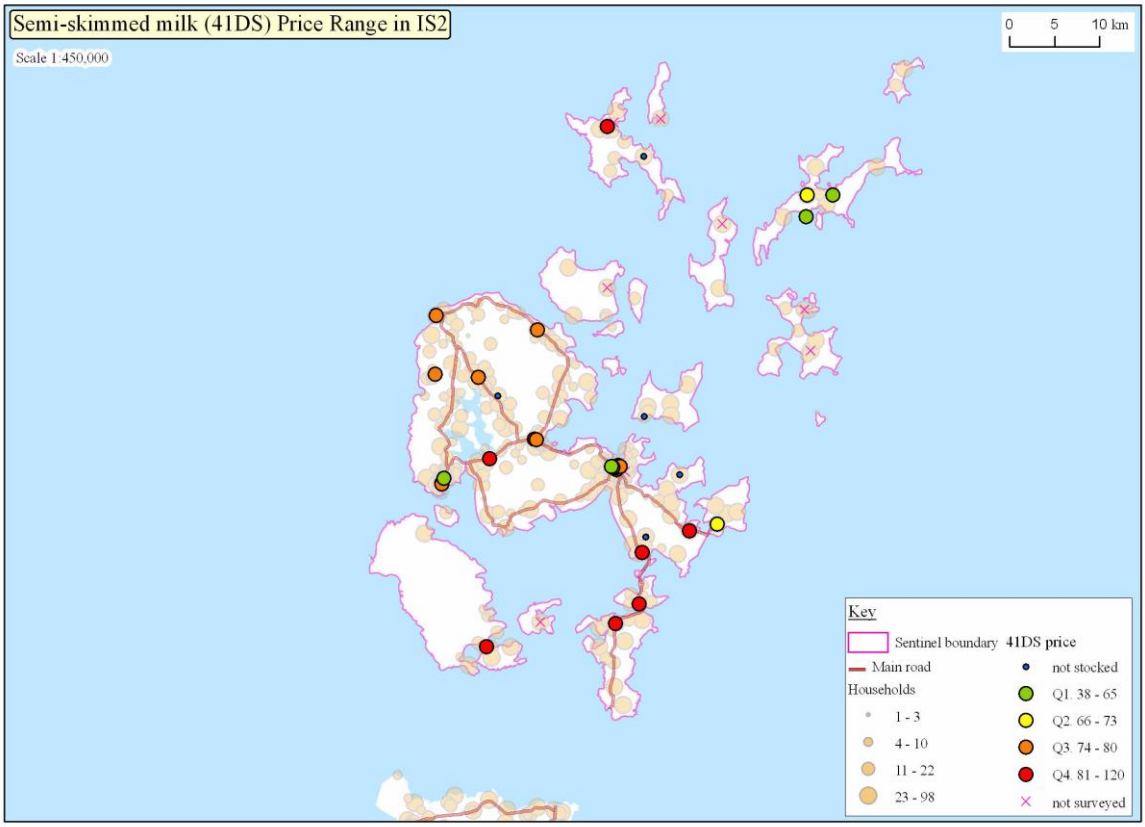

Apple (10FA) Price Range in ST2
Scale 1:40,000
ST2e
ST2c
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

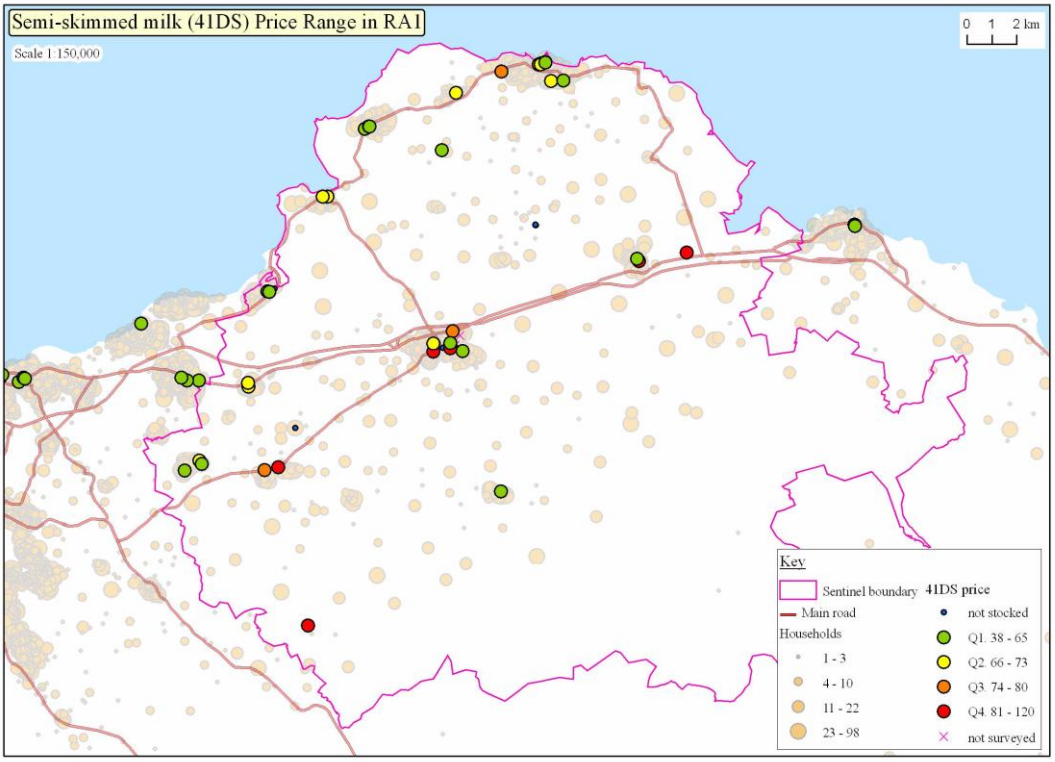

Apple (10FA) Price Range in UR1
Scale 1:40,000
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

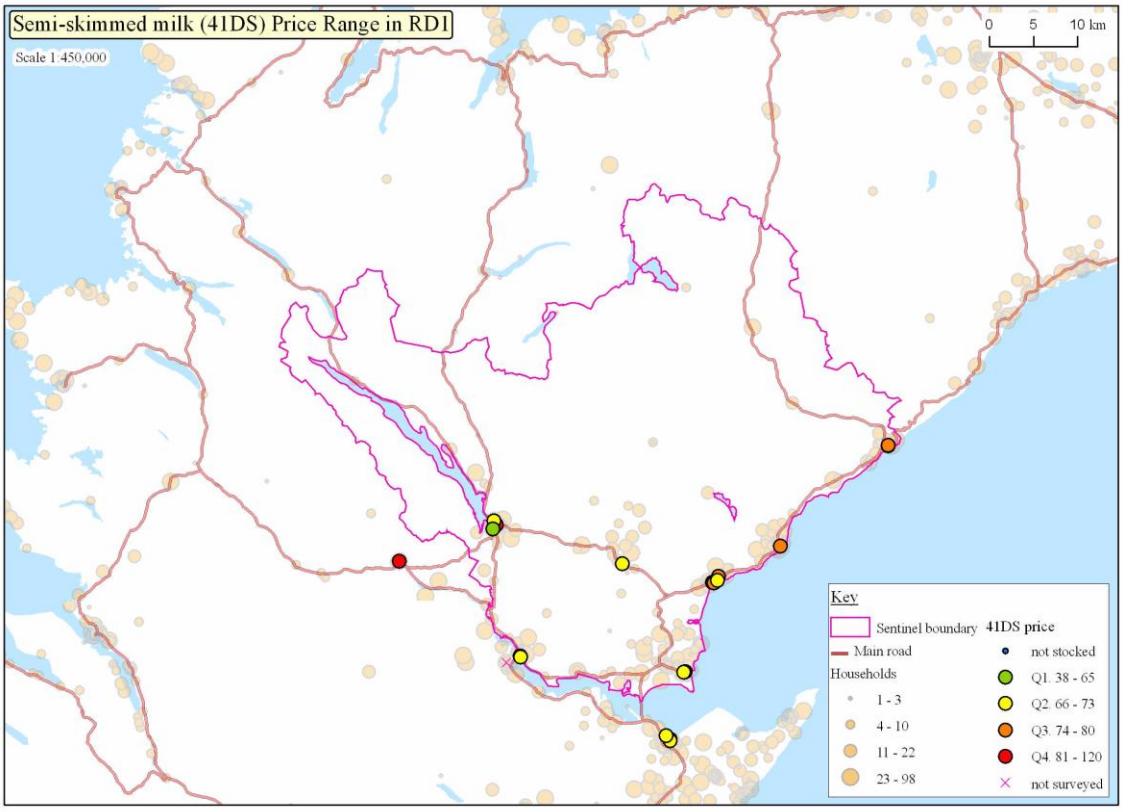

Apple (10FA) Price Range in UR2
Scale 1:40,000
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

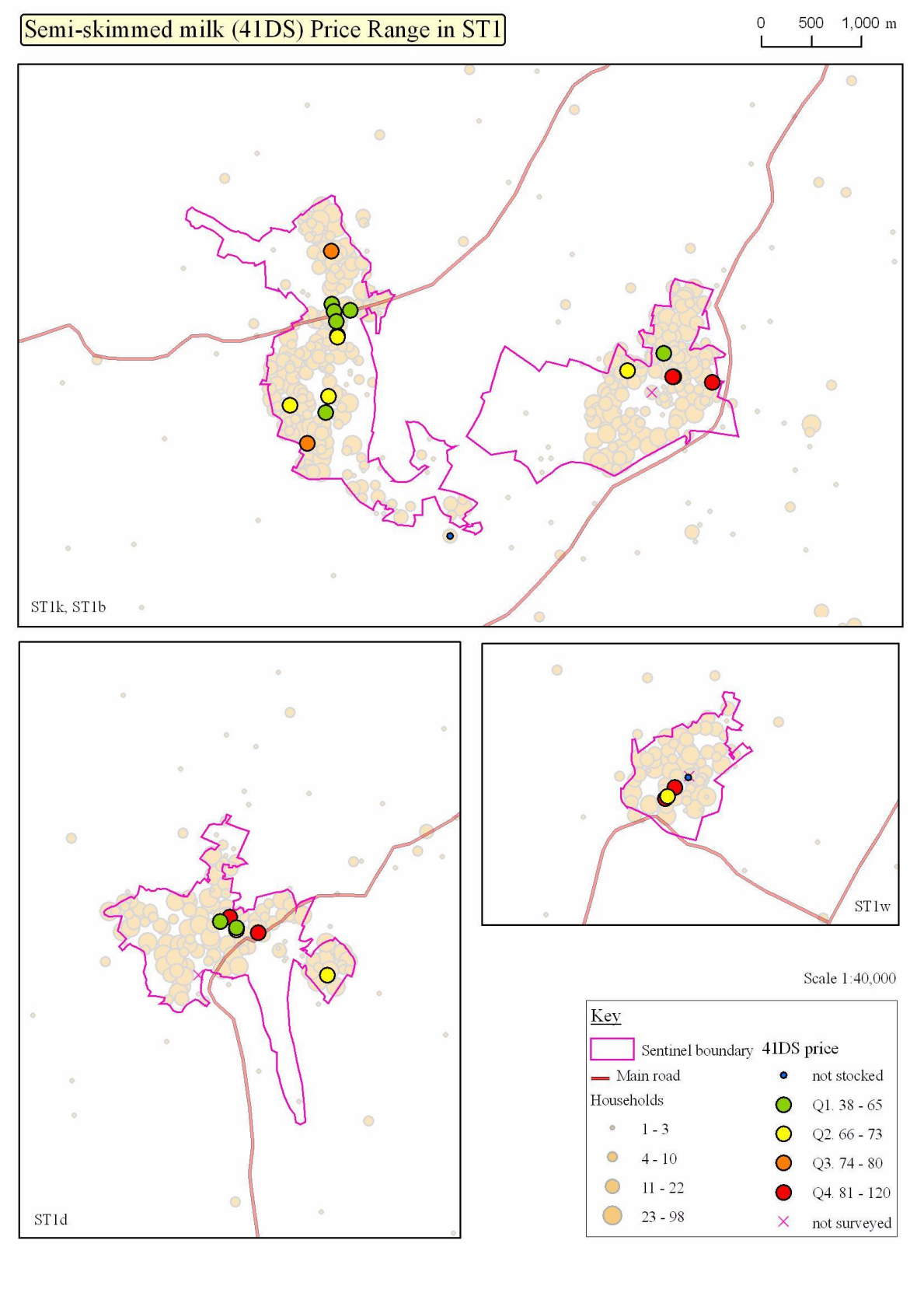

Apple (10FA) Price Range in UR3
Scale 1:40,000
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
10FA price
not stocked
Q1. => 109
Q2. 110 - 125
Q3. 126 - 156
Q4. 157 =<
not surveyed

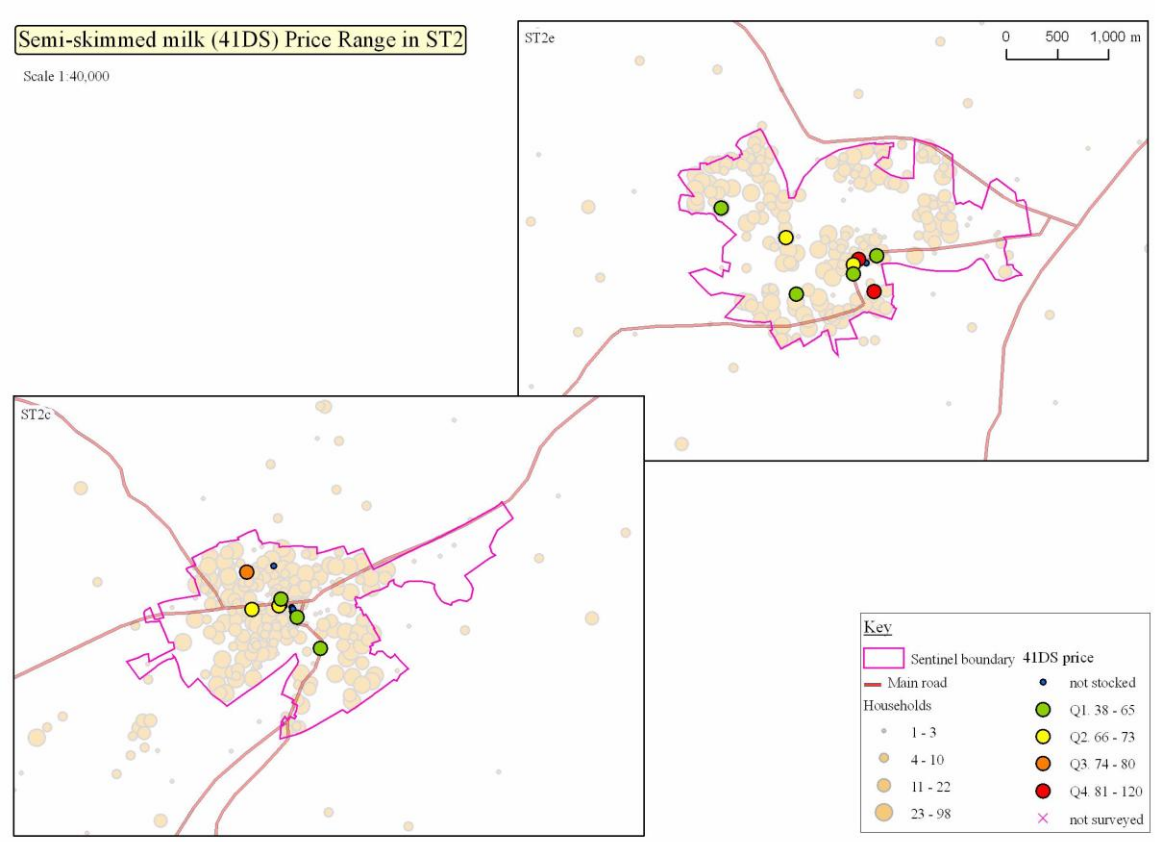

Semi-skimmed milk (41DS) Price Range in IS1
Scale 1:450,000
IS1s
IS1n
0 5 10 km
Key
Sentinel boundary
41DS price
Main road
not stocked
Households
Q1. 38 - 65
1 - 3
Q2. 66 - 73
4 - 10
Q3. 74 - 80
11 - 22
Q4. 81 - 120
23 - 98
not surveyed

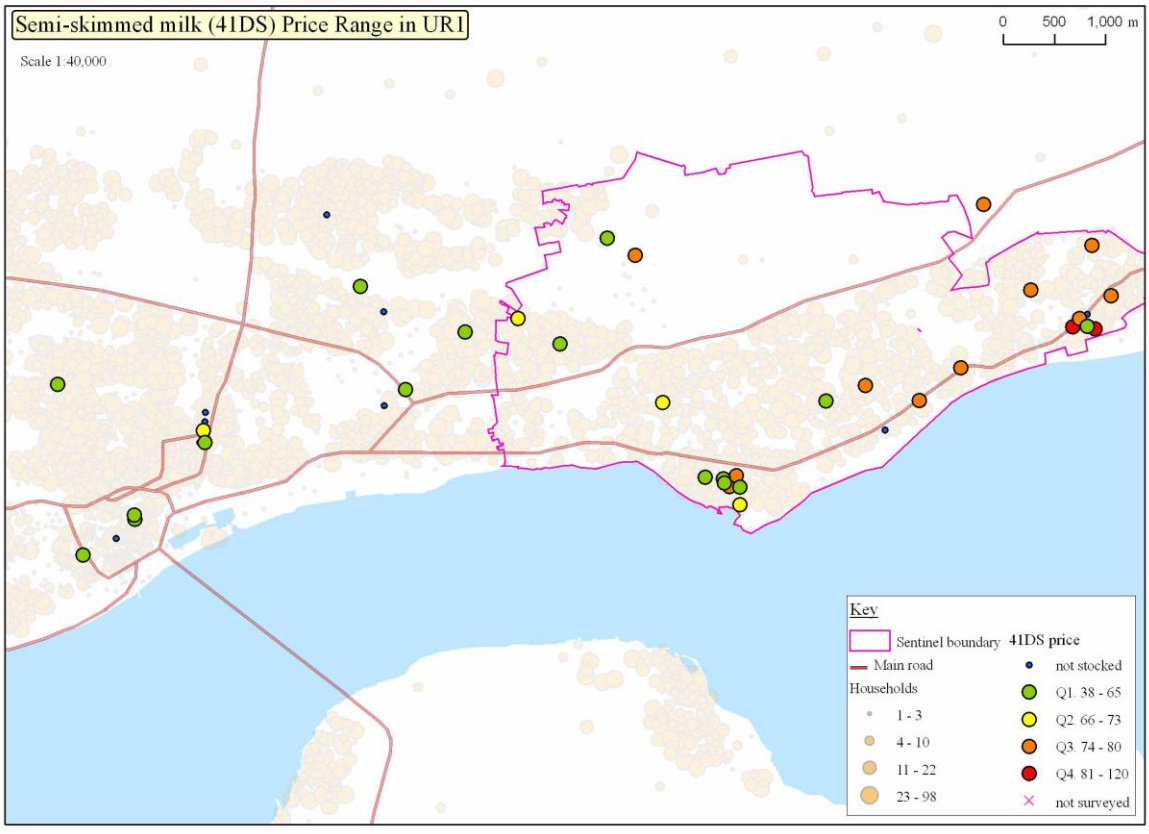

Semi-skimmed milk (41DS) Price Range in IS2
Scale 1:450,000
0 5 10 km
Key
Sentinel boundary
41DS price
Main road
not stocked
Households
Q1. 38 - 65
1 - 3
Q2. 66 - 73
4 - 10
Q3. 74 - 80
11 - 22
Q4. 81 - 120
23 - 98
not surveyed

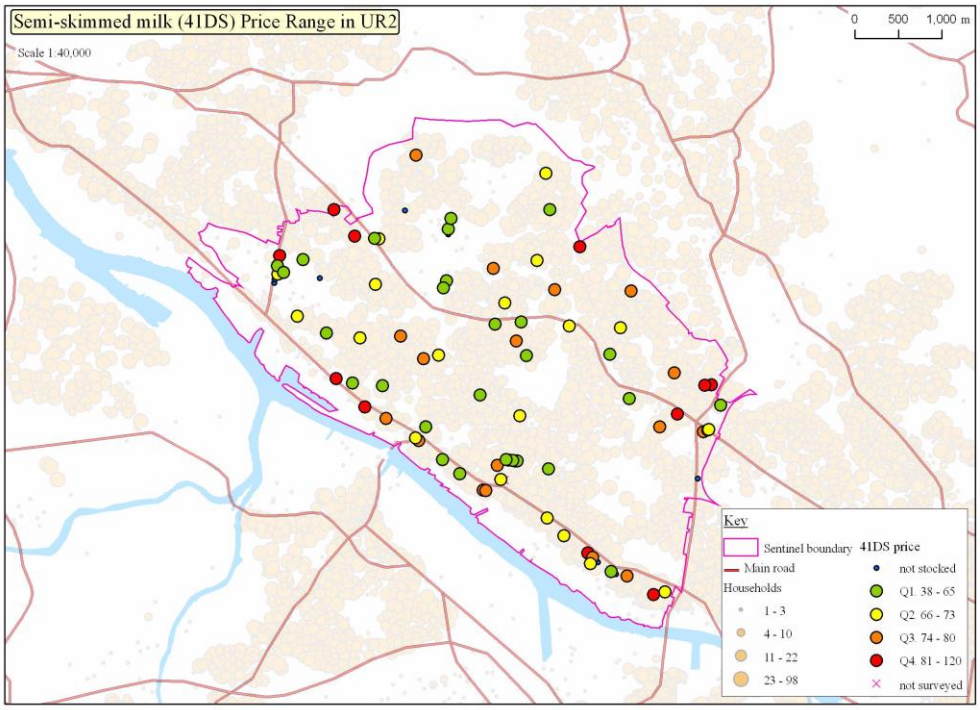

Semi-skimmed milk (41DS) Price Range in RA1
Scale 1:150,000
0 1 2 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
41DS price
not stocked
Q1. 38 - 65
Q2. 66 - 73
Q3. 74 - 80
Q4. 81 - 120
not surveyed

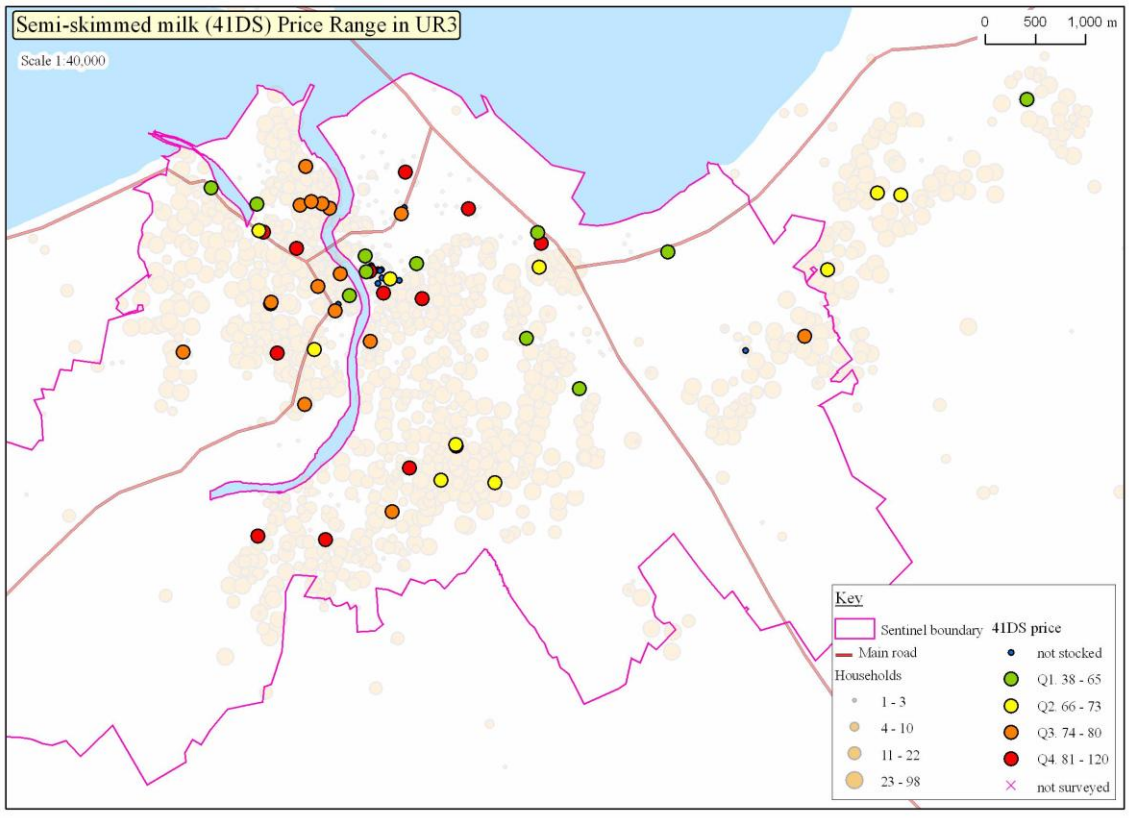

Semi-skimmed milk (41DS) Price Range in RD1
Scale 1:450,000
0 5 10 km
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
41DS price
not stocked
Q1. 38 - 65
Q2. 66 - 73
Q3. 74 - 80
Q4. 81 - 120
not surveyed


Semi-skimmed milk (41DS) Price Range in ST1
0 500 1,000 m
ST1k, ST1b
ST1d
ST1w
Scale 1:40,000
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
41DS price
not stocked
Q1. 38 - 65
Q2. 66 - 73
Q3. 74 - 80
Q4. 81 - 120
not surveyed


Semi-skimmed milk (41DS) Price Range in ST2
Scale 1:40,000
ST2e
0 500 1,000 m
ST2c
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
41DS price
not stocked
Q1. 38 - 65
Q2. 66 - 73
Q3. 74 - 80
Q4. 81 - 120
not surveyed


Semi-skimmed milk (41DS) Price Range in UR1
Scale 1:40,000
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
41DS price
not stocked
Q1. 38 - 65
Q2. 66 - 73
Q3. 74 - 80
Q4. 81 - 120
not surveyed


Semi-skimmed milk (41DS) Price Range in UR2
Scale 1:40,000
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
41DS price
not stocked
Q1 38 - 65
Q2 66 - 73
Q3 74 - 80
Q4 81 - 120
not surveyed

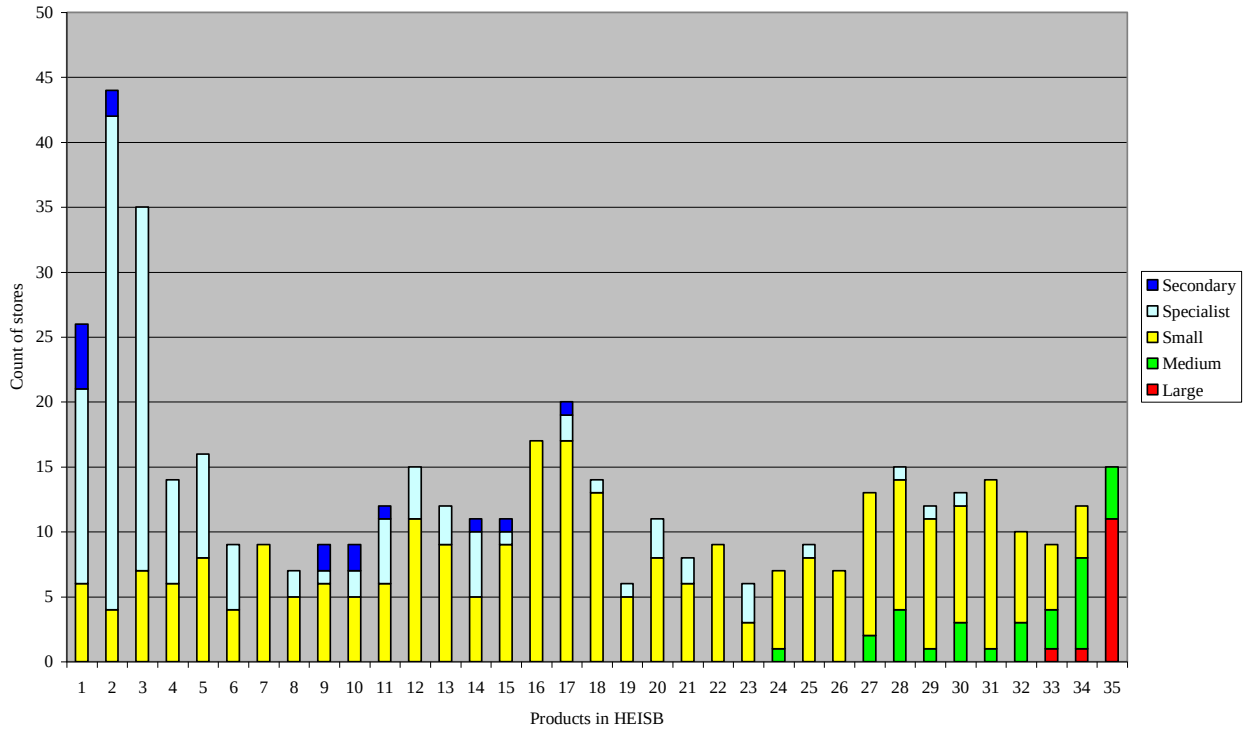

Semi-skimmed milk (41DS) Price Range in UR3
Scale 1:40,000
0 500 1,000 m
Key
Sentinel boundary
Main road
Households
1 - 3
4 - 10
11 - 22
23 - 98
41DS price
not stocked
Q1 38 - 65
Q2 66 - 73
Q3 74 - 80
Q4 81 - 120
not surveyed

3.8.9. Access to high HEISB stores

This analysis considers stores that stock consistently higher levels of HEISB across food groups and the average distance of the sentinel population to them.

Looking at the number of different HEISB products stocked by store type it seems there is no clear distinction between store types and especially between many Small, Medium and Large types of general store. It seemed somewhat of an arbitrary distinction to say, for instance, 28 products = 4th quintile not high HEISB; 29 products = 5th quintile is high HEISB. See Figure 6 below.

Figure 6: Frequency distribution of HIESB products stocked and store type



It was therefore decided to look at which stores stock consistently higher levels of the range across the whole HEISB. A store was deemed to stock a higher level of HEISB within a food group if it stocked 50% or more HEISB products by food group. This produced the following count requirements by food group (Table 54). The Meal grouping has not been included in this classification as it only contains 1 item (Lasagne).

Table 54: Product count required for high HEISB classification

	Total HEISB	Number required for high
Fruit	7	4
Veg	10	5
Carb	9	5
Protein	4	2
Dairy	4	2
Total	34	18

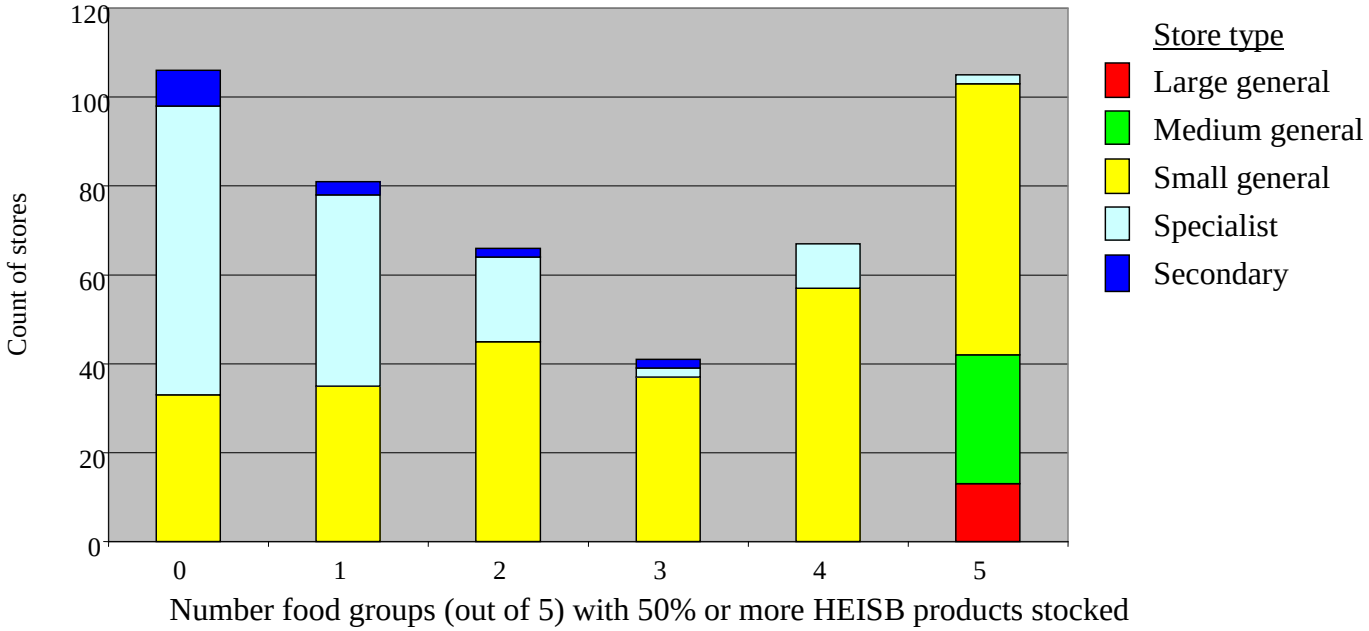
Within the sentinel stores 105 stores stocked all 5 food groups with the required product counts from Table 54. This included all the Large and Medium store types, 61 Small stores and 2 Specialists. See Table 55 below.

Table 55: Frequency distribution of stores stocking high levels of HEISB across food groups

Count	Store type					
Number food groups high	Large	Medium	Small	Specialist	Secondary	Total
0			33	65	8	106
1			35	43	3	81
2			45	19	2	66
3			37	2	2	41
4			57	10		67
5	13	29	61	2		105
Total	13	29	268	141	15	466

Figure 7 below shows the frequency distribution of store types by number of food groups with a high HEISB stocking.

Figure 7: Frequency distribution of store types stocking high levels of HEISB across food groups



A map was produced for each sentinel showing the zonal average (mean) straight line distance by data zone polygon to the nearest high HEISB store. These maps constitute set 15. A high HEISB store was deemed to be one stocking 5 out of 5 food groups at 50% or more. Buffer high HEISB stores were included in this mapping process to try to minimise the edge effect of mapping retail access with artificial (i.e. sentinel boundaries). Buffer stores are not shown in the tables above.

Straight line distance calculations underestimate the true travel distances for the population to access the stores. However it is expected that the same underestimation applies similarly in each of the environments: urban, small town, rural and island. Comparisons within environments are still practicable. The underestimation will increase as road networks become more sparse with increasing remoteness.

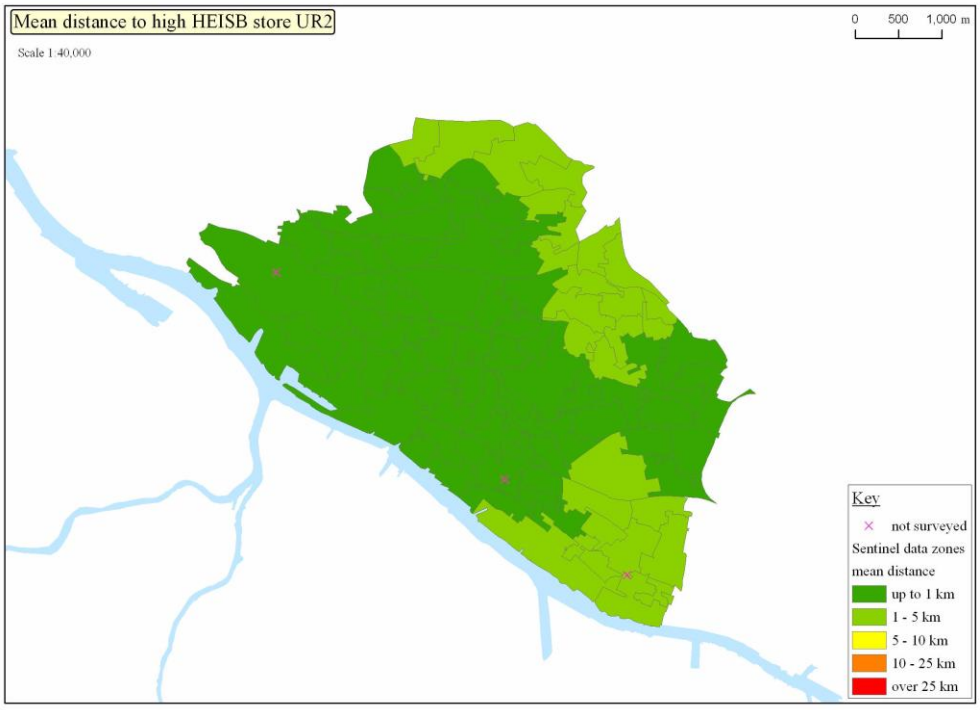
Each of the urban maps shows a similar pattern with data zones being either up to 1km or between 1 and 5 km from a high HEISB store.

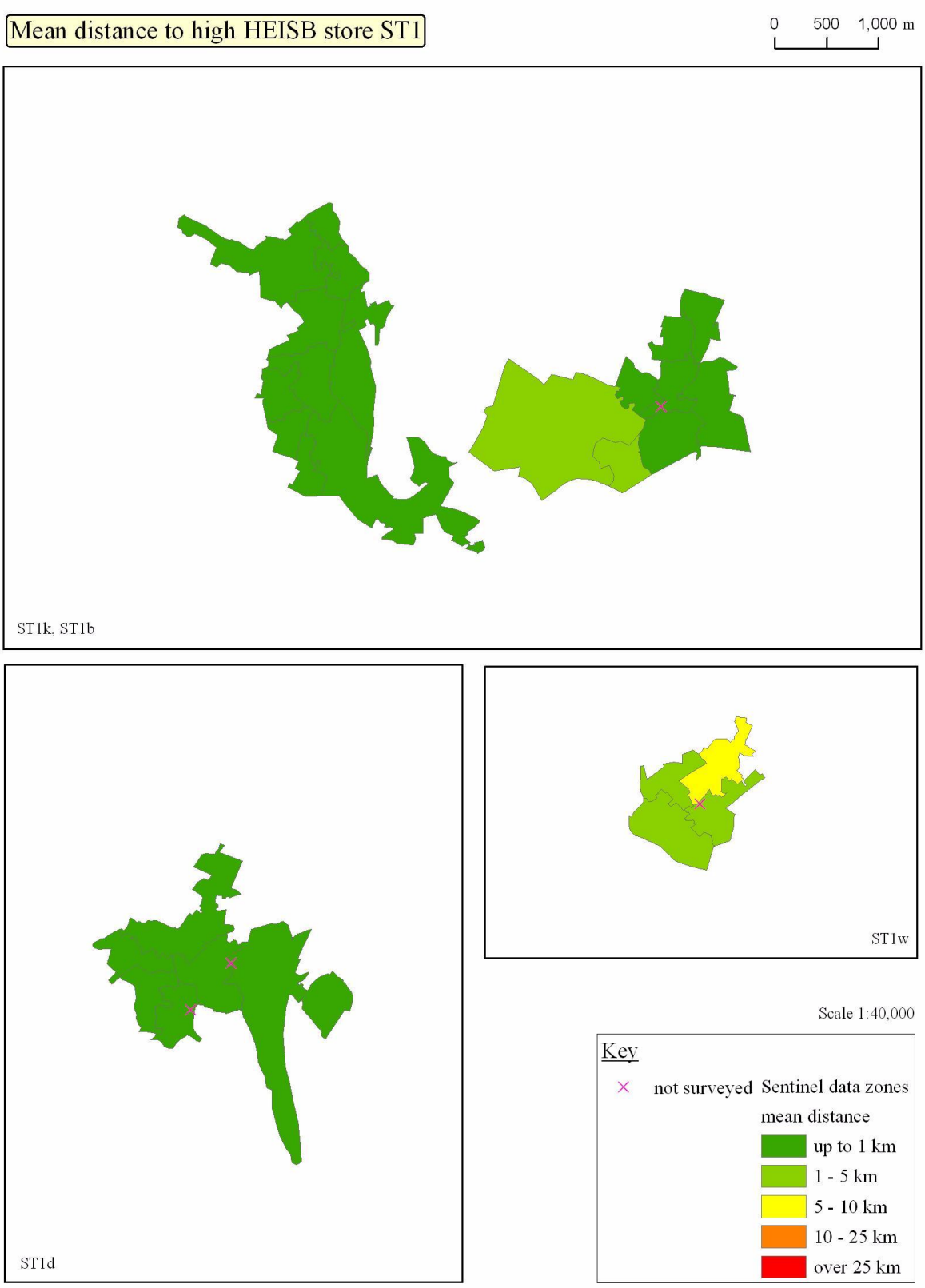
Similarly in the small towns data zones are almost entirely either up to 1km or between 1 and 5 km from a high HEISB store with one data zone being between 5 – 10 km. However there was a survey refusal in that area (ST1 - pink cross).

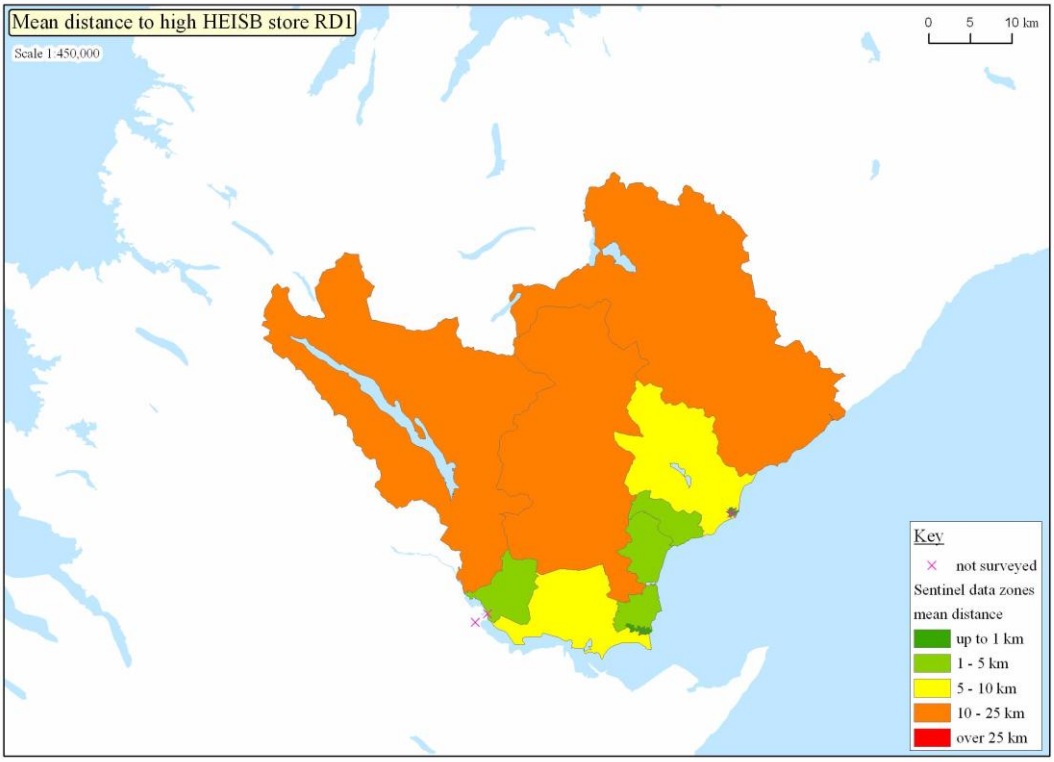
In the rural affluent sentinel RA1 the data zones in the small towns are up to 1 km from a high HEISB store and the rural data zones are either between 1 and 5 km from a high HEISB store or between 5 and 10 km.

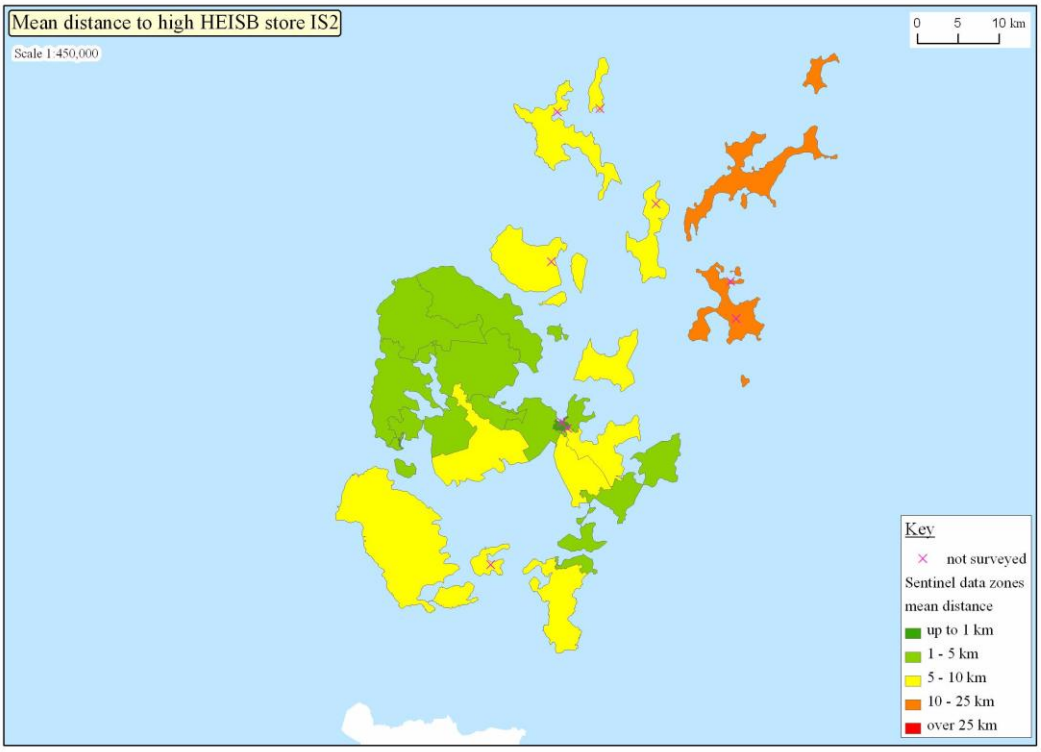
The rural deprived sentinel RD1 shows a similar pattern to RA1 although there are 3 data zones between 10 and 25 km from a high HEISB store.

The island data zones show a distribution of data zones between 1 to 5 km, 5 to 10 km and 10 to 25 km.




Mean distance to high HEISB store ST1
0 500 1,000 m
ST1k, ST1b
ST1w
ST1d
Scale 1:40,000
Key
not surveyed
Sentinel data zones
mean distance
up to 1 km
1 - 5 km
5 - 10 km
10 - 25 km
over 25 km


Mean distance to high HEISB store RD1
Scale 1:450,000
0 5 10 km
Key
not surveyed
Sentinel data zones
mean distance
up to 1 km
1 - 5 km
5 - 10 km
10 - 25 km
over 25 km

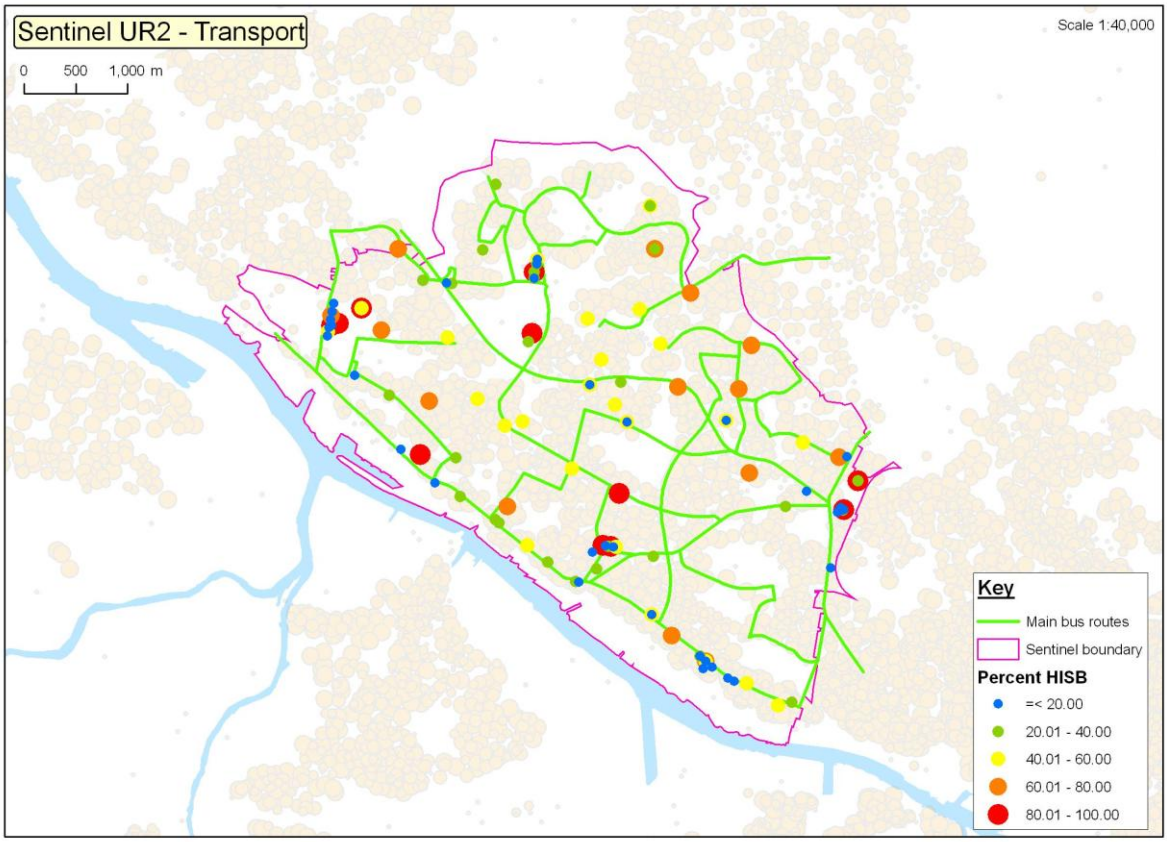

Mean distance to high HEISB store IS2
Scale 1:450,000
0 5 10 km
Key
not surveyed
Sentinel data zones
mean distance
up to 1 km
1 - 5 km
5 - 10 km
10 - 25 km
over 25 km

3.9. Transport access

Data were collected on transport routes and services in sentinels. The following shows the analysis for sentinel UR2.

For sentinel UR2 the main bus routes with a frequency of 1 per hour or greater, during weekdays, were digitised. Figure 9 shows these with the food stores plotted also.

Figure 8: Main bus routes in urban deprived sentinel UR2



It can be seen that almost all the stores stocking a high percentage of the HEISB lie on the main bus routes. Figure 9 and Figure 10 show that almost all the population lies within 333m of the main bus route and all the population lies within 500 m of a main bus route.

Figure 9: 333m walk zone to main bus route sentinel UR2

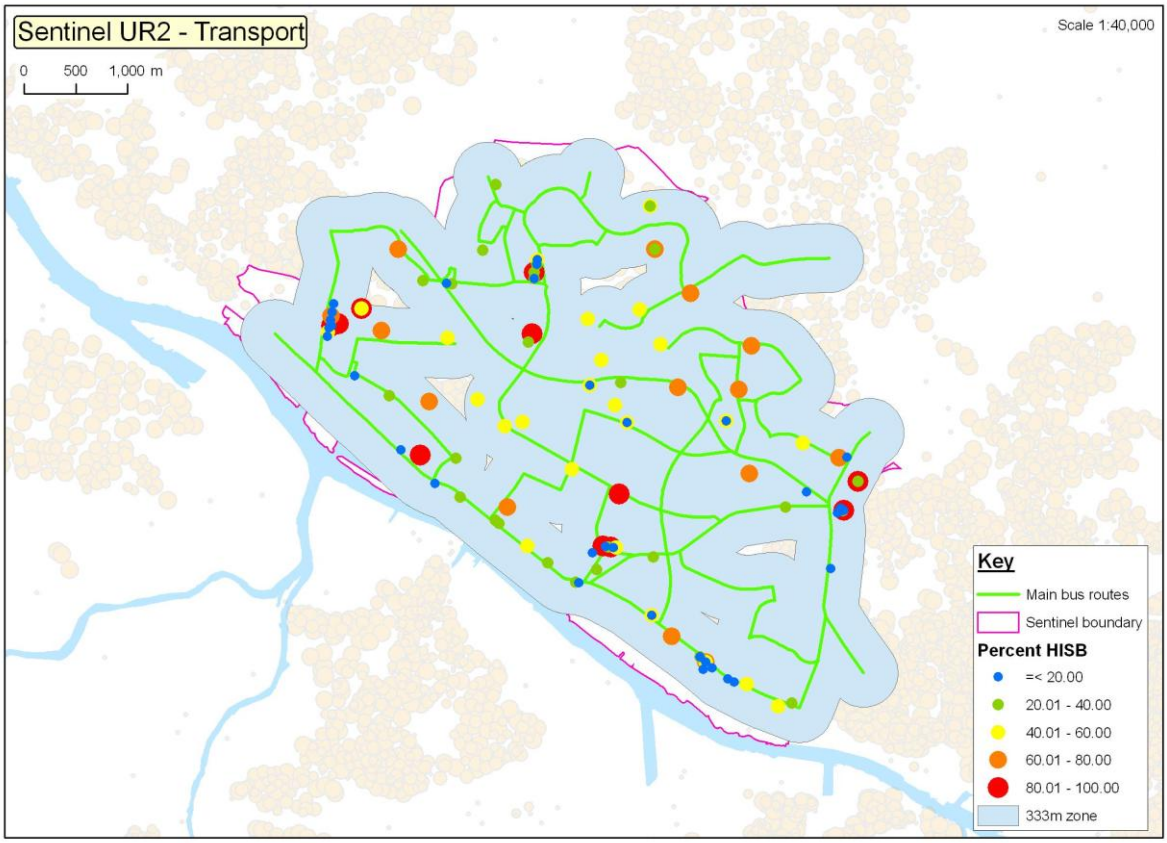
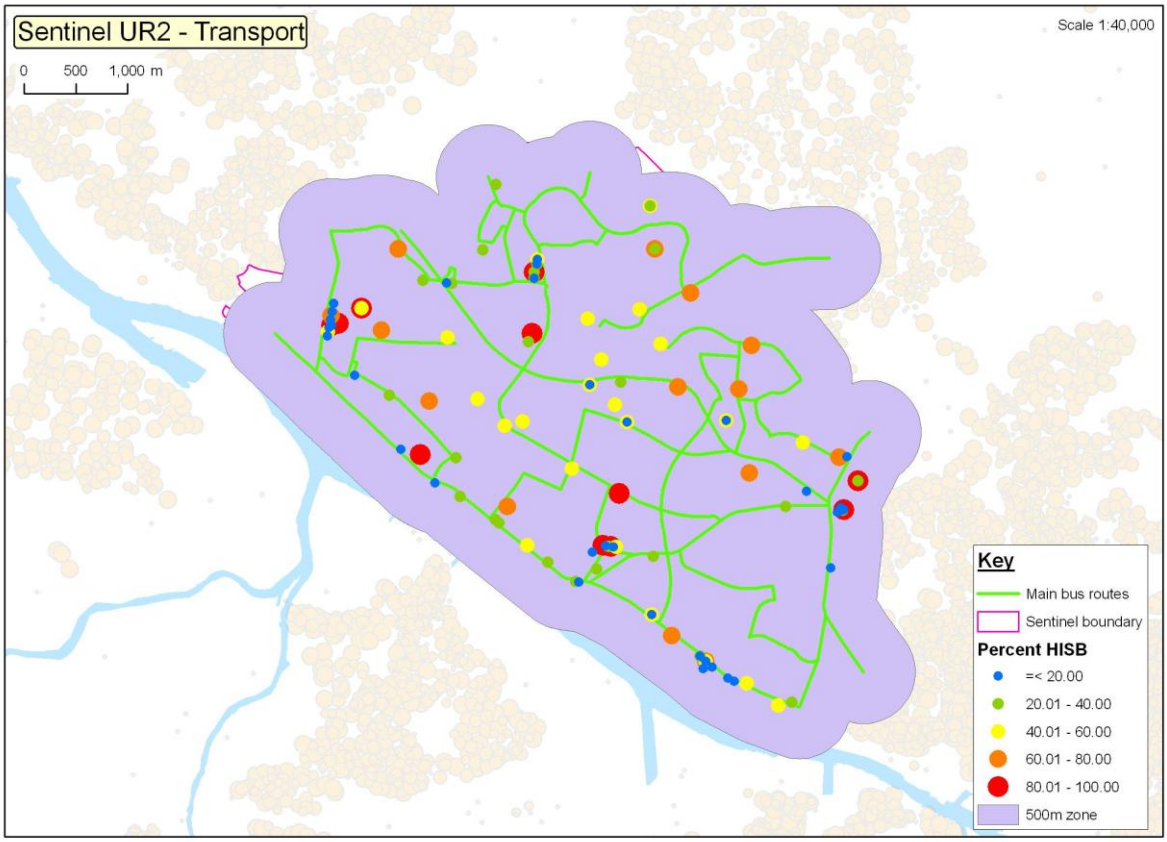


Figure 10: 500m walk zone to main bus route sentinel UR2



3.10. National maps

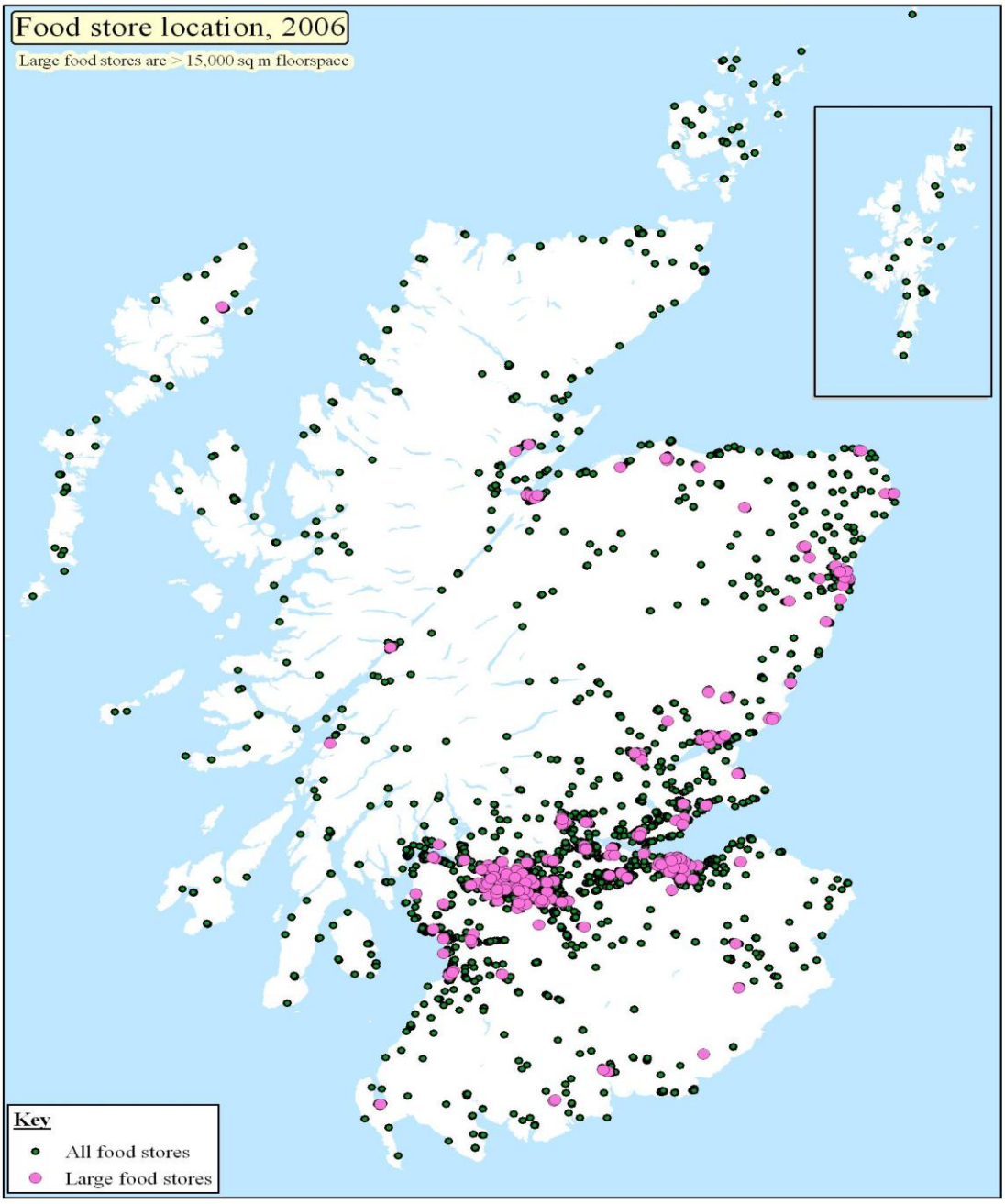
3.10.1. The Scottish food retail sector

A census of food shops in 5.7% of Scotland (370 out of 6505 data zones) has been taken. 491 food shops were identified and 466 of them were surveyed. The entire population of Scottish food stores is not known with estimates varying from 6000-9000. The project has produced an accurate database of food retailing in 5.7% of Scotland. It has also produced a database of food retailing containing 5923 shops from national sources for the whole of Scotland. This is approximately 1500 units less that the median of estimated national totals. But it is believed that this project's database is presently the most comprehensive available although it is appreciated that there may be some undercounting in the large urban areas.

3.10.2. Food store location

Figure 11 shows that there is a wide coverage of food stores of all types, both general and specialist (n = 5923), across Scotland. The coverage of large general food stores (i.e. those greater than 15,000 sq ft sales area, n = 212) is more limited.

Figure 11: Food store location, 2006



The provision of large food stores related to population, at a local authority level, is shown in Figure 12. This shows that there is approximately a 4-fold variation in provision, using this calculation[5], from 5-8 persons per square metre to 20-23 persons. Two local authority areas, Orkney and Shetland, had no known food stores greater than 15,000 sq ft sales area at the time of calculation. Population figures used were the most recent estimates available from the GROS at a local authority level. The figures for large food stores were produced by this project using industry body and company sources.

[5] Total estimated population for a local authority divided by the total estimated sales floor space of large food stores within the same local authority.

Figure 12: Population per unit area large food store

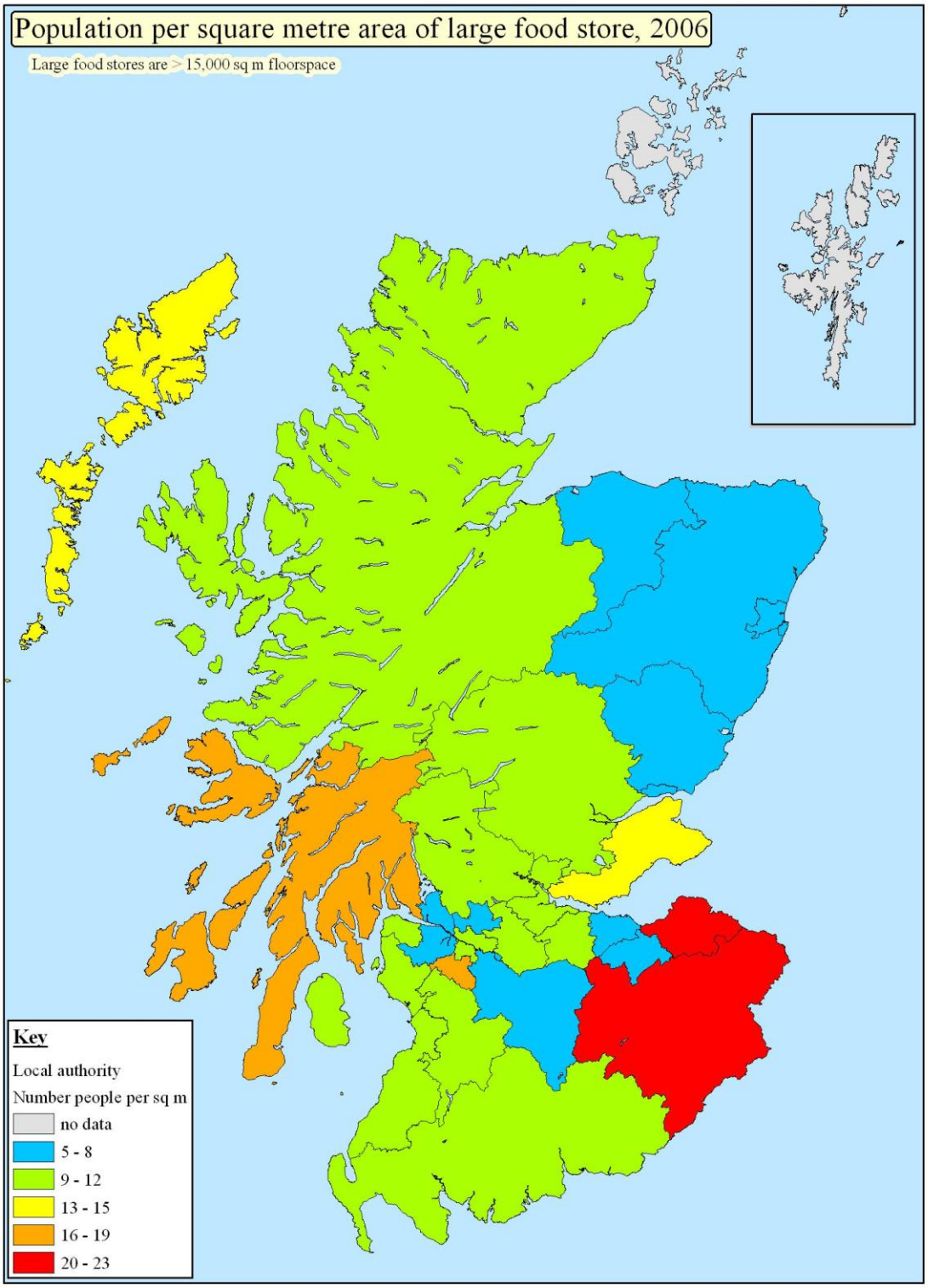
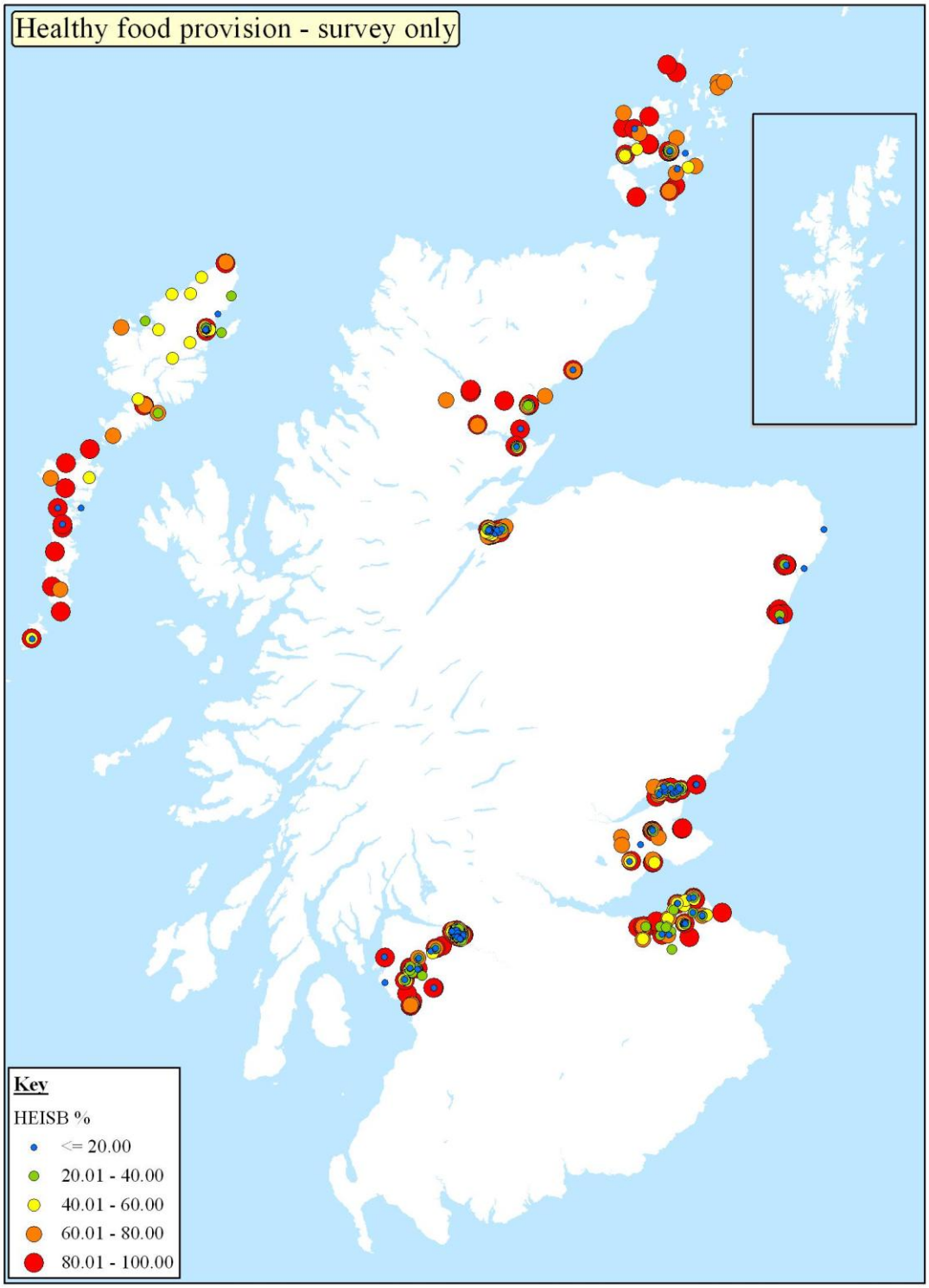


Figure 13 shows the HEISB survey results for the stores surveyed in the project (n = 564). Mapped stores are limited to the sentinel areas and buffers. If detailed data for the whole of Scotland were available then this would show the wide variation of HEISB availability across the country.

Figure 13: Healthy food provision – survey areas only



The current research has shown that higher levels of HEISB can be found in large, medium and small sized general food stores (see section 3.2 and section 3.8.9), although it is predominantly a feature of large and medium sized stores. Figure 14 shows the average distance, at a data zone level, to the nearest large or medium general store (n = 900) across Scotland.

Figure 14: Distance to nearest large or medium general store

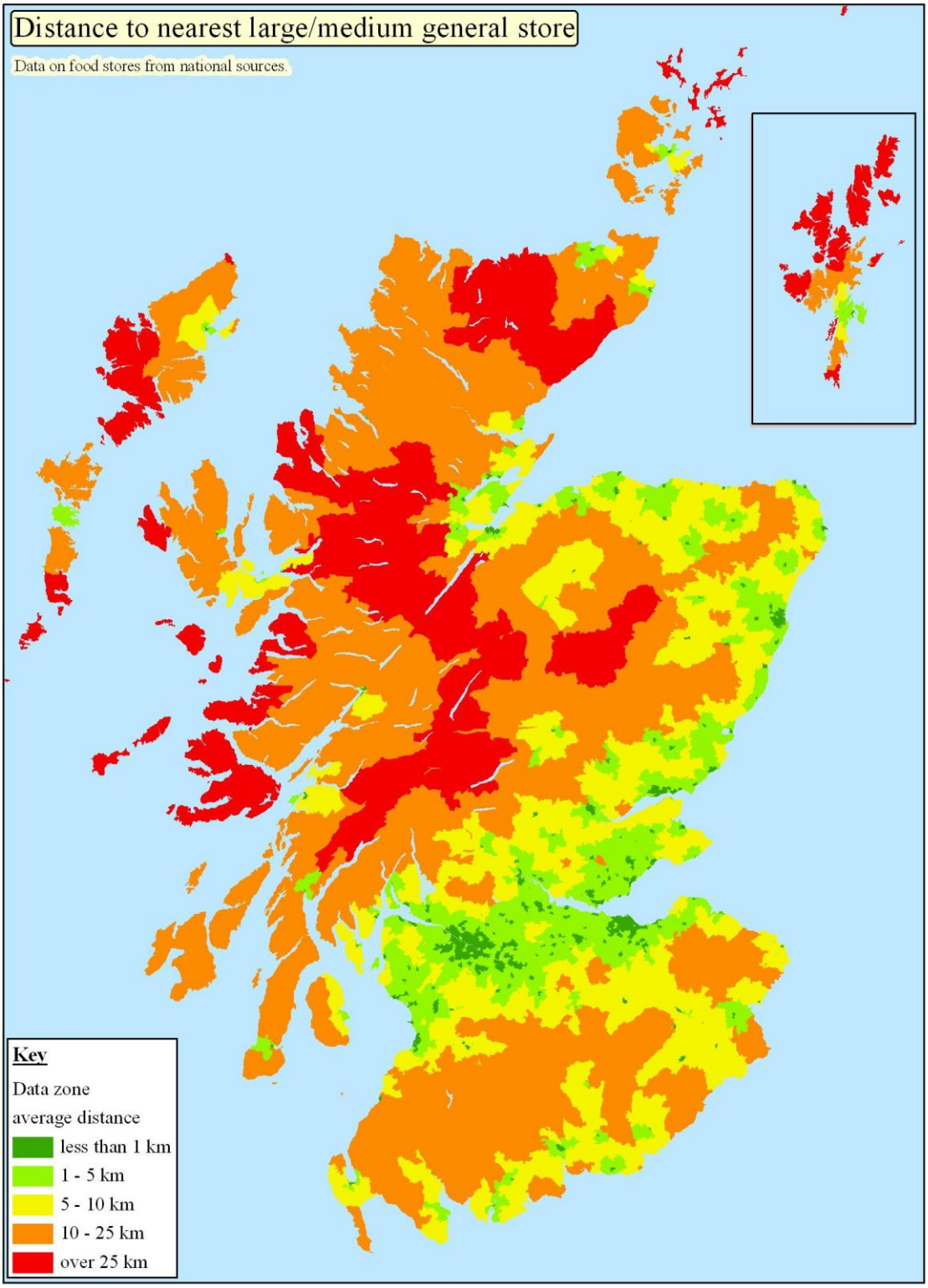


Table 56 summarises the data zone average distances by local authority (sorted alphabetically) and population levels. It can be seen that, for example, Aberdeen City has a total population of 203,450, and 73% of that population lives in data zones closer than 1 km to a medium or large general food store. But there are several local authority areas where less than 50% of the population lives within 1 km of a medium or large general food store. In some cases more than 25% of the population of the area lives more than 5 kms from such a store.

Table 56: Population and Average Distance to Large or Medium Store

		count	%	count	%	count	%	count	%	count	%
Local authority	Total Popn	< 1 km	< 1 km	1 - 5 km	1 - 5 km	5 - 10 km	5 - 10 km	10 - 25 km	10 - 25 km	over 25 km	over 25 km
Aberdeen City	203,450	148,221	73%	48,843	24%	6,386	3%		0%		0%
Aberdeenshire	232,850	80,717	35%	56,868	24%	61,372	26%	32,786	14%	1,107	0%
Angus	108,560	60,705	56%	35,296	33%	10,865	10%	1,694	2%		0%
Argyll and Bute	91,190	33,311	37%	27,535	30%	7,727	8%	17,077	19%	5,540	6%
Clackmannanshire	48,240	14,490	30%	26,539	55%	6,734	14%	477	1%		0%
Dumfries and Galloway	147,930	44,428	30%	36,041	24%	35,851	24%	31,610	21%		0%
Dundee City	141,870	116,004	82%	25,866	18%		0%		0%		0%
East Ayrshire	119,720	55,020	46%	36,221	30%	19,172	16%	9,307	8%		0%
East Dunbartonshire	106,550	50,365	47%	54,366	51%	1,819	2%		0%		0%
East Lothian	91,580	47,477	52%	32,085	35%	9,431	10%	2,587	3%		0%
East Renfrewshire	89,610	45,852	51%	41,192	46%	2,566	3%		0%		0%
Edinburgh, City of	453,670	392,387	86%	61,283	14%		0%		0%		0%
Eilean Siar	26,260	4,017	15%	4,952	19%	3,945	15%	7,656	29%	5,690	22%
Falkirk	147,460	70,921	48%	72,700	49%	3,839	3%		0%		0%
Fife	354,600	202,220	57%	124,806	35%	27,574	8%		0%		0%
Glasgow City	577,670	505,396	87%	72,274	13%		0%		0%		0%
Highland	211,340	67,701	32%	63,053	30%	26,334	12%	40,537	19%	13,715	6%
Inverclyde	82,430	31,211	38%	44,202	54%	7,017	9%		0%		0%
Midlothian	79,610	52,687	66%	25,772	32%	1,151	1%		0%		0%
Moray	87,720	39,610	45%	24,466	28%	18,265	21%	5,379	6%		0%
North Ayrshire	136,020	66,599	49%	57,808	42%	9,739	7%	1,874	1%		0%
North Lanarkshire	322,790	168,717	52%	152,495	47%	1,578	0%		0%		0%
Orkney Islands	19,500	4,314	22%	3,042	16%	1,803	9%	8,627	44%	1,714	9%
Perth and Kinross	137,520	61,125	44%	33,981	25%	30,911	22%	10,868	8%	635	0%
Renfrewshire	170,610	104,384	61%	63,542	37%	2,684	2%		0%		0%

Table 56 continued: Population and Average Distance to Large or Medium Store

		count	%	count	%	count	%	count	%	count	%
Local authority	Total Popn	< 1 km	< 1 km	1 – 5 km	1 - 5 km	5 - 10 km	5 - 10 km	10 - 25 km	10 - 25 km	over 25 km	over 25 km
Scottish Borders	109,270	49,108	45%	12,408	11%	26,654	24%	21,100	19%		0%
Shetland Islands	21,940	4,051	18%	4,360	20%	2,229	10%	3,871	18%	7,429	34%
South Ayrshire	111,850	56,891	51%	34,388	31%	13,988	13%	6,583	6%		0%
South Lanarkshire	305,410	196,793	64%	81,233	27%	20,922	7%	6,462	2%		0%
Stirling	86,370	37,690	44%	28,104	33%	11,092	13%	8,976	10%	508	1%
West Dunbartonshire	91,970	54,503	59%	36,794	40%	673	1%		0%		0%
West Lothian	162,840	92,650	57%	69,207	43%	983	1%		0%		0%
National Total	5,078,400	2,959,565	58%	1,491,722	29%	373,304	7%	217,471	4%	36,338	1%

Table 57 shows the mean distance to a medium or large general food store by local authority. The mean distances have been population weighted by data zone and then sorted in ascending order of distance.

Table 57: Mean distance to a medium/large food store

Local authority	Mean distance (m)	Local authority	Mean distance (m)
Glasgow City	605	East Lothian	2,115
Edinburgh, City of	637	Inverclyde	2,209
Dundee City	689	Clackmannanshire	2,510
Aberdeen City	1,057	South Ayrshire	2,633
West Dunbartonshire	1,094	Moray	3,254
Midlothian	1,124	East Ayrshire	3,259
West Lothian	1,169	Stirling	3,409
North Lanarkshire	1,191	Perth and Kinross	3,764
Renfrewshire	1,229	Aberdeenshire	4,685
East Renfrewshire	1,289	Scottish Borders	4,874
East Dunbartonshire	1,357	Dumfries and Galloway	5,950
Falkirk	1,407	Highland	6,935
Fife	1,555	Argyll and Bute	7,175
South Lanarkshire	1,640	Orkney Islands	11,551
North Ayrshire	1,753	Eilean Siar	15,259
Angus	2,092	Shetland Islands	17,424
National mean	2,328		

Note that the national mean distance to a medium/large food store is 2,328 m. This is calculated including the Island communities . However this statistic should be compared with the figure of 58% of the population living within 1 km of a medium/large food store shown in Table . Therefore the national median distance to a medium/large food store is under 1 km. When all 6505 data zones are sorted in order of increasing distance, the median value of the 3253rd data zone is 832m. When population is used to find the median data zone, i.e. where the 2539200/1 people live, this occurs in the 3232nd data zone with a mean distance value of 828m.

3.11. Summary of key points from analysis

Retail Provision

- Over half the stores surveyed were small general food stores and almost a third were specialists.
- Three sentinels did not contain a large general food store (i.e. a large supermarket/hypermarket "one-stop shop" type).
- Freezer centres were only found in urban areas and specialist greengrocers were only found in small town or accessible rural areas.
- In general the most deprived data zones have the greatest number of food retail shops located within them.
- The mapped distribution of stores across Scotland shows a pattern associated with population but an estimated 250,000 people live more than 10km from a large or medium sized food store. Approximately 3 million live within 1 km of a large or medium sized store.

HEISB availability by store type

- The HEISB acts as a satisfactory general tool to discriminate amongst the range of choices available for healthy foods.
- The HEISB discriminated well between different individual stores within the small general, specialist and food secondary store types.
- There was wide variation in availability. Only large, and some medium, sized general stores regularly stocked the entire HEISB.
- Semi-skimmed milk was the most widely stocked healthy food; brown rice and frozen berries were the least widely stocked.
- Baked beans and semi-skimmed milk were most likely to be stocked across all types of general food store.
- The fruit group was generally more available than the vegetable group.
- The detailed maps show that within sentinels there is considerable range of availability of HEISB across the shop population.

HEISB price variability and promotional activity

- Items with the greatest price variability are frozen peas, brown rice and spaghetti.
- Those with the least are semi-skimmed milk, oven chips, salmon and beef mince.
- Less common items such as frozen berries and grapes have larger absolute price ranges but lower relative variability.
- Chicken breasts, salmon fillets, baked beans, oven chips and low fat yoghurt were the five most heavily promoted items.
- Medium sized general stores showed most promotional activity.
- Areas with a higher rate of promotions are cheaper than areas with a lower rate.
- At individual store level within sentinels the maps show considerable range of prices within sentinels.

HEISB availability and price in different areas

- The HEISB is a useful tool to discriminate access to healthy foods in different areas.
- Whilst overall the level of access could be deemed to be good there are significant difference in levels of access to particular food groups. The differences in access reflect strongly the nature of the retail structure of an area with the presence of a large store resulting in a high level of availability of all items in the HEISB
- On an area basis there is no evidence of urban "food deserts" by price.
- Map analysis show the considerable differences in food store and HEISB provision across Scotland as shown by the different sentinel areas.

HEISB availability and price by deprivation

- There is some evidence that some basic products, in particular the meat and fish items, are less available in more deprived areas but there is no consistent pattern.
- If the large store factor is removed then it appears that some food groups are less available in areas of high deprivation as measured by SIMD. Whilst fruit and carbohydrates relatively available this is not the case for vegetables.
- From the analysis of the individual SIMD domains there is some evidence to suggest there tends to be particularly poorer availability of some items for deprivation based on income, employment, health and crime. In areas of high income deprivation there is poorer access to vegetables and also poorer access to basic fruit such as oranges and to some protein foods, for example lean mince and chicken breasts. A similar relationship is seen in areas with health deprivation where 37% of the HEISB items show a trend towards lower availability as health deprivation increases.
- There was no consistent evidence of deprived areas being more expensive across the total HEISB but the affluent sentinels are associated with lower prices in 33 of the 35 items in the HEISB. In general price seems to rise with deprivation across quintiles 1,2,3,4 then in quintile 5 it falls.
- Map analysis of the Urban Deprived sentinel UR2 illustrates the relatively high availability of fruit and poorer availability of proteins in the HEISB.

HEISB availability and price by urban/rural location

- When access is considered in respect of urban and rural communities the pattern is complex. When comparing urban deprived areas and rural deprived areas the access to HEISB items is better in the rural deprived areas.
- The two affluent small town sentinel sites were the cheapest places to purchase the total HEISB basket with rural deprived and island mixed/deprived the two most expensive.

- Urban deprived and rural/island mixed/deprived have the greatest proportion of items on promotion for each individual food item. This contributes to the lower costs of total baskets in these areas.

HEISB quality

- Large general food stores have the smallest proportion of fresh fruit and vegetable items rated as poor quality.
- Small general stores had the greatest proportion of items rated as poor quality
- No store type had zero percent of items rated as poor quality.
- In general deprived sentinels had a greater proportion of their fresh produce rated as poor quality compared to their affluent counterparts.

Opening hours

- Opening hours were positively correlated with deprivation and amount of the HEISB stocked.
- Urban mixed areas had the longest opening hours and island mixed/deprived the shortest.

3.12 Discussion

Concerns over the relationships of diet to health in Scotland have resulted in a number of governmental initiatives to try to improve the health of the Scottish population. The nature of the relationships is far from clear such that policy initiatives have had limited success if evaluated in terms of measured improvements in health. One of the several issues that has been raised in this connection is the question of differences in accessibility to and affordability of food that would be the basis of a healthy diet. In particular questions have been raised as to whether the socio-spatial patterns of affluence and deprivation and the environmental-spatial patterns of rurality and urbanism have relationships to the issues of accessibility and affordability of healthy food. It is these questions that have been addressed in the research project.

The research produced a unique Food Map of Scotland locating 5923 food stores that provided a foundation for the study of food access and availability at a national level. On this foundation the project explored the availability of healthy food items in terms of their provision in stores and their price. The healthy food items surveyed were selected as indicator foods and were selected on the basis of nutritional composition, broad food category, ubiquity of consumption and place in a Scottish diet. The second phase of the research collected detailed data in 466 stores within 9 sentinels. These were considered representative of areas at the extremes of urban-rural and deprived–affluent dimensions. The survey was carried out to a rigorous methodology with a high level of statistical validity.

The study focused specifically on access and availability and did not explore issues either of consumer behaviour or of the consumption of food items. Only food items considered as 'healthy' were surveyed; less healthy foods were excluded from study. Budgetary constraints restricted the number of areas and shops surveyed and the inclusion of more areas would have provided more data. However, the areas surveyed provide an insight into food access and availability across Scotland and provide the basis for future investigation.

Whilst there are no directly comparable studies to the one undertaken, it is possible to place the results of the current study in the context of the limited number of related studies. The current research provided a national map of retail food outlets in Scotland, using a GIS. When a mapping exercise has been undertaken in previous studies it has been limited to small areas and without the detailed spatial referencing provided by a GIS. The research undertaken for the current study therefore provides a unique picture of the location of food stores in Scotland enabling the calculation of national levels of access to food stores in Scotland.

In addition to the compilation of national data the current research has undertaken detailed studies in sample small areas. With the exception of Clarke et al 1995, the other studies are limited to urban areas and focus on issues linked to deprivation. Thus, these previous studies are considerably more limited in coverage compared with the present study that considers both rural and urban environments and deprived and affluent situations. Broadly, the conclusions in the current small area studies confirm indicative conclusions from these related research studies. The related studies of Cummins and Macintyre 2002, Wrigley 2002, and White et al 2004, as does the

current study, provide little support for claims for the presence of local food deserts. The physical access to food stores with a range of healthy products is not a substantive problem. There were no major issues of accessibility problems to a food store. This of course does not deny that individual consumers may have specific access issues at very particular times or locations.

In terms of food choice, this research confirms previous work that food choice in deprived areas tends to be more range constrained and prices are higher. Contrary to previous research on Scottish island communities, (Clark et al 1995) good provision and access can be found in some remote areas. This good provision, however, comes at a higher price. It can be concluded that access to a large store is more important than the presence of a network of small stores in providing access a range of healthy food choices. This suggests, contrary to Clarke et al (2002) that a network of small stores with limited choice may not be the optimum solution for consumer welfare in this context.

These findings are broadly in line with other FSA research, the ***Low Income, Diet and Nutrition*** study, undertaken in UK contemporaneously with the current study. This study based on consumer studies, in contrast to the research in this report which was based on supply side considerations, included a small sample of consumers in Scotland. Consumer participants were asked about shopping practices, food security and barriers to healthy eating and the overall results suggest that across the UK participants perceived price as more important than food access as a barrier to obtaining healthy foods. The demand side derived conclusions from the UK wide ***Low Income, Diet and Nutrition*** concur with the supply side conclusions from the current Scottish study.

Access to food is facilitated by the retail system and its management. Retailers in general respond to the demands of the customers but retailers also are able to shape these demands by providing particular product ranges, merchandising items in particular ways, and pricing and promoting items in particular ways. The retailers' approaches to management generate the possibilities of availability of food items, with the consumer then deciding, subject to various influences by the retailer, which to purchase. How the consumer then uses these food items, possibly along with others obtained from non-retail sources, determines diet. In all this process, the consumer decision process is heavily influenced by their knowledge of food and diet.

Within this complex nexus of diet building this project has focused on one aspect of the total structure, namely the extent to which the availability and price of particular foods are related to the presence of a network of stores and the location of the store in respect of being in a deprived or affluent area and an urban or rural area.

Given the importance of the retail sector in delivering access to food it is perhaps surprising that no consolidated listing of food stores and their characteristics exists either for the UK overall or for Scotland. Official statistical sources contain some data but this is incomplete and relates to several years prior to their publication. These official data are of limited value for analysing retail provision. The first requirement of the current project therefore was to generate as comprehensive as possible listing of food shops together with their spatial co-ordinates so that a GIS could be used to map them. This involved combining lists from a variety of sources to produce a map of the

5923 shops identified. It is believed that this listing and map is comprehensive for all outlets greater than 3000 sq ft but that some small shops have not been captured either because they are not included on the various listings and sources used or that the range of foods being sold is very limited. The network of stores is dynamic. Stores close and others open. The large firms in retailing have a programme of store opening that involves addition to the network of stores larger than 3000 sq ft and in some cases involves new very large stores in excess of 25,000 sq ft. The map, and the GIS database on which it is based, provided one foundation for the research project and as such needs to be monitored and updated on a regular basis.

A second foundation aspect of the project is a listing of indicator healthy foods that provide the basis for survey work on availability and price in network of stores. Previous research projects in England have developed lists of food items that have been used to assess availability. In many cases these have been associated with projects that have sought to explore availability in respect of particular groups of consumers, for example particular ethnic groups, rather than to the general population as is the aim of the current project. Other projects, with the aim of establishing the presence or not of 'food deserts', have developed surveys of access to food items across the full spectrum of foods, for example the study by White et al (2004), rather than limited to indicator healthy foods as is the aim of the current project. The list of 35 healthy foods (termed HEISB) developed for his project can be seen as a potentially widely applicable tool that, with minor changes to reflect the locality of the study, can be used by other research groups to measure issues of accessibility and affordability of healthy foods.

The research design of the current study highlighted the implied causal variables of degree of affluence/deprivation and of urbanism/rurality as affecting the degree of availability and the price of the HEISB. The research, however, was essentially exploratory rather than hypothesis based because the nature of the implied causality was unclear. Whilst there have been many studies, dating back over several decades (Caplovitz 1963, Williams 1977), that suggest that 'the poor pay more' and so higher prices, for many services not only food, might be expected in more deprived areas there are also studies that suggest that if consumer incomes are higher then retailers are likely to respond with raising prices. In similar fashion whilst there are lines of argument to suggest that higher costs of procurement in rural areas and lower inter-store competition may result in higher prices there are also arguments that lower operating costs of stores in rural areas and higher mobility in rural populations can be factors resulting in a lowering of rural prices. The exploratory nature of the research resulted in a unique research design for the study in which groups of paired survey areas were designated to reflect positions at the poles of the two dimensions underpinning the implied causality. In each of the survey areas, termed survey sentinels, a census of shops was undertaken to establish presence and price of the HEISB. Such an approach is unique within the body of research on this overall topic.

In undertaking the research it was necessary to address an issue of multiple comparisons in the statistical analyses. Multiple comparison problems occur when one subjects a number of independent observations to the same acceptance criterion that would be used when considering a single event. For example, if the tester ran one hundred comparison-of-means tests with a 5% significance level, five statistically significant associations would have occurred due to chance (a false positive result).

For example in this report multiple tests of the mean price of individual food items using ANOVA has occurred and this opens up the need to consider the possibility of false positives. Continuing the example of ANOVA, as assessment of the problems of multiple comparison can be dealt with by comparing all possible pairs of means in order to discover which pairs of means are significantly different under some selected probability level (usually 0.05). Although this technique resembles multiple t-tests, the difference is that the probability levels are controlled to account for the multiple tests. Popular tests include Newman-Keuls, Tukey and Bonferonni.

Multiple comparison procedures were not considered imperative in this case for two reasons. First, it is not clear whether individual food items are truly independent of each other. For example it is likely that certain food groups are sourced from the same supplier/producer and thus could be correlated in some way due to the fixed costs of running the store or firm. Secondly, as findings generally do not exhibit a consistent pattern and little can be specifically inferred from the data presented it was felt that correcting for multiple comparisons would not change the conclusions of this report in any substantial manner. As a result we reported individual p-values rather that categorising statistical significance as anything over $p>0.05$ in order to aid the reader when making inferences from the data presented.

The p values derived from the data and reported in the tables, together with the regression analyses, are indicative of, rather than clear proof for, relationships and have been interpreted in this way. Importantly they provide a basis for the development of additional hypotheses that can be tested both with more detailed analyses of the data collected and from additional surveys, should the toolkit developed in the project be used to monitor changes in access or price of healthy food.

The results of the census of stores provided data on 466 stores in the survey sentinels. Over half the stores surveyed were small (less than 3000 sq ft) general food stores with most of them being operated by micro firms. A further third were specialists food stores with butchers and bakers the most common types. Only 13 stores were large (over 25,000 sq ft) supermarket/hypermarket type shops. Freezer centres were limited to urban areas and specialist greengrocers generally were located in small towns or accessible rural areas. A higher density of food shops, in particular small food shops, existed in the most deprived (SIMD measure) areas, and the relationship of store density was broadly linear with deprivation. This pattern is not unexpected being partly as a consequence of relatively high population densities in these areas of higher deprivation and also the reduced attractiveness of these areas for investment in medium sized and large stores. The higher population density makes them attractive for entrepreneurs operating small low investment stores that because of a low volume of sales often have to source from relatively expensive distribution channels thus making it necessary to charge higher prices in order to survive.

The HEISB acts as a satisfactory tool to discriminate amongst the range of choices available for healthy foods, and also between different types of store. The variation in availability identified in the survey, reflected strongly the presence of large and medium sized food stores. Only large, and some medium, sized general stores regularly stocked the entire HEISB (median of 100% and 91.4% of HEISB items respectively) and thus can be thought of as providing a full range of healthy food items. Small stores are much more variable (median 50% of HEISB items stocked).

Across all shop types, semi-skimmed milk was the most widely stocked healthy item; brown rice and frozen berries were the least widely stocked items. Only 7%, 9% and 12% of small food stores stocked salmon fillets, brown rice and frozen berries respectively. The fruit group was generally more available than the vegetable group in small food stores.

The pattern of availability in the small stores can be explained, to a considerable extent, by the management approaches used by small firms who are the dominant organisational form operating the small shops. Whilst there is clearly a range in managerial abilities across the small store sector, for the more progressive small firms/stores it is sensible to stock those items that will generate more sales – thus the availability of semi-skim milk – and not to stock items with low demand, for example brown rice. From the retailer perspective, increasing the demand for low demand items is more difficult for the small firm that the large firm because of the limited space availability for promotional material, the lack of scale economies in buying, and the high risk involved if demand does not increase. Consequently not stocking those items is a sensible merchandising policy. The wider availability of fruit than vegetables is related to shelf life of the items in HEISB. With the exception of onions and potatoes, the fresh vegetables, broccoli, lettuce, cucumber, etc have a relatively short shelf life, compared with oranges, apples, etc and so pose a higher risk when demand is low. Stocking the longer shelf-life items is a sensible managerial response to low volume.

Given this pattern then the small retailer is likely to increase the range of vegetables only if the demand increases for the short-life products. If the consumers visiting the shop generate higher demand then more is likely to be stocked, at least in those small firms that have a progressive approach to management.

The position with the medium sized and large sized stores is different. Within this group, the small convenience supermarkets, discount supermarkets, supermarkets and superstores are generally operated by medium sized and large firms that operate multiple outlets. The opportunity to carry a wider range is present because sales volumes of stores are greater, product rotation is faster, scale economies of sourcing exist even for low volume items and so both short-life and low volume items can be part of the range. Furthermore, the opportunities in these stores, because of their size, for successful merchandising and in-store promotional initiatives are greater than for the small firm/store operations. In the case of these larger stores, therefore, there are more possibilities for influencing demand when the customer is in-store.

The survey suggested that when access is considered in respect of urban and rural communities the pattern is more complex. This survey does not provide evidence to support the findings of earlier work, of more than a decade ago, by Clark *et al* (1995) in their study of the Western Isles which highlighted the very limited availability of food items, particularly fresh fruit and vegetables, and high prices consequent on transportation costs. It is likely that within the last decade the position has changed. The present survey suggests that in general when comparing urban deprived areas and rural deprived areas, the access to HEISB items is better in the rural deprived areas. This is the position also when comparing urban deprived with the Island sentinels. For example when the proportion of stores stocking HEISB items is compared between urban deprived and rural deprived then for 33 of the 35 items the proportion of stores

stocking the item is greater in the rural deprived sentinel. When the mixed/affluent Orkney Island sentinel is compared with Scotstoun then for 32 of the items the proportion of stores stocking the item is greater in the Orkney Island sentinel.

The likely reasons for the higher levels of stocking of HEISB in rural areas, despite larger populations per shop in the urban areas, are complex. The more dense network of shops in urban areas may generate a higher degree of inter-shop competition that results in lower prices (see below) and greater pressure to stock only items that sell in reasonable volume. In addition within the rural areas where the number of specialist stores is lower then the general stores are more inclined to stock a wider range. In addition, food shops in rural areas are more dispersed geographically, and distance may prevent or reduce the likelihood of regular supermarket shopping. This may lead to a wider range of foods, including healthier foods being sold and stocked by smaller shops.

Within urban Newcastle, White *et al* (2004) concluded that "food deserts" only exist for a minority of people who do not or cannot shop outside their immediate locality and for whom the locality suffers from poor retail provision of foods that make up a 'healthy' diet. Previous, and considerably earlier, work within Glasgow and Edinburgh (Sooman *et al* 1993, Forsyth *et al* 1994, Edinburgh Community Food Initiative 1999) suggested that healthy food was less available and more expensive in poorer compared to richer urban areas within Scotland. The results of the present study suggest no clear simple pattern in the availability between affluent and deprived urban areas but do not support the idea that healthy food items are not available in deprived areas.

Large differences in the price of HEISB items were recorded across the store types and across sentinels. Shopping in large general food stores yields the cheapest median price (£37.48) for the total basket of food items in our survey compared to other general stores, specialist stores and stores where food is secondary. There appears to be a price gradient within general stores with median total basket price increasing as the store gets smaller with the median price for HEISB in the small general stores at £47.83 being over £10 more than in large stores. This result is confirmatory evidence of large stores being lower priced generally and it is interesting that this is also the case for the healthy food indicator items.

Whilst the relationship of price with shop type is clear the pattern of price as related to deprivation is more complex. There is no evidence of the most deprived areas being the most expensive across the total HEISB but the affluent sentinels are associated with lower prices in 33 of the 35 items in the HEISB. Price seems to rise with deprivation across quintiles 1,2,3,4 then in quintile 5, the most deprived, it falls. The two affluent small town sentinel sites were the cheapest places to purchase the total HEISB basket with rural deprived and island mixed/deprived the two most expensive.

A possible explanation of this pattern is related to a mix of managerial action and the network of store provision. As deprivation increases so consumer mobility and level of information decreases and prices are higher. This pattern is one of the key concepts that have for many years been underpinning arguments in the literature on 'why the poor pay more'. But for the most deprived areas with the lowest incomes this approach to pricing is not possible and prices are below those in the somewhat less

deprived areas. Alongside this managerial view the relatively high population density in urban deprived areas encourages a higher density of stores such that inter-store price competition, and notably promotional activity, is greater than in the areas of lesser deprivation.

The relationship between price and deprivation is further complicated by the environment with cost differentials in store operations as between rural and urban areas affecting pricing. The most expensive HEISB by sentinel is rural deprived at £52.75 with Island Mixed/Deprived at £49.15. Small town affluent at £42.30 is the lowest priced of the sentinel areas. Although in the survey of availability it was seen that many small general food stores, in many cases in rural areas, had a relatively high percentage availability of indicator foods, it is apparent that this comes at a relatively high price. Even for the rural affluent sentinel the overall price of HEISB is 10% more than the urban affluent.

Although the study has not proved a conclusive link between deprivation and price of HEISB, those living in deprived rural, island and small town sentinels, pay a higher price for the HEISB than their more affluent counterparts. For the urban sentinels there is little difference in price between affluent and deprived.

There are many difficulties in drawing conclusions about price differentials given the frequency with which prices may change due to product availability and promotion. Nonetheless the magnitude of the price differences recorded is such as to indicate that there are differences in actual sale prices being recorded in the survey. The product range of stores is a very important consideration in examining price variation and in considering the impact on affordability.

From this discussion it can be seen that simple claims of ‘food deserts’ and poor availability of food items in rural areas, whilst possibly being issues of the early 1990s, are not supported by the evidence in this project. The factors underpinning access and price to healthy foods are extremely complex. Managerial decisions within the network of, often independent, stores lies at the heart of what items are stocked and the prices at which they are offered.

The research has explored one aspect only of the complex nexus of relationships that link food purchasing to diet. The project has not considered what items consumers actually buy and how they use the items that are purchased. It has also not explored the issues associated with the knowledge of consumers of the healthiness or otherwise of particular food items.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The key conclusions that can be drawn from the project are:

- The HEISB instrument of 35 indicator products and survey implementation using GIS methods has proven to be useful for the detailed study of food access in specific areas and is of a form that is able to provide data to monitor change in food access. The HEISB instrument can be used to discriminate amongst shops providing low, medium and high levels of healthy food in different types of area.
- The accessibility to healthy food is determined by the network of stores in an area and by the stocking policy of those stores. There is a consistent high level of availability in both large and medium general stores. Availability in small general food stores is related to the remoteness of the area with a higher level of HEISB provision in small general stores in more remote areas than in urban areas. Across small general food stores in less remote areas, availability varies considerably by food group, such that population groups that depend on the small food stores for food provisioning will have more limited access to healthy foods than if they utilised the larger stores in their area.
- The price of healthy foods as shown by HEISB varies considerably by store type and by area. It is lower in large and medium sized stores than in small stores. Thus the retail structure of an area is an important factor in influencing price of healthy food. There is a tendency for prices to be lower in areas with a low level of social and economic deprivation.
- The associations between access to and the price of healthy food and rural-urban and deprived-affluent areas are complex and whilst the research has not proven conclusively that a link exists there are indications that a full range of healthy food is less consistently accessible in urban deprived areas than elsewhere and also the price is higher in some types of deprived areas, not necessarily the most deprived.

- From the research we conclude that within the sentinels there were no major issues of accessibility to a food store. The presence of 'food deserts', that has been the subject of debate in the media and popular press, is not supported from the evidence of this project. Inevitably within any area there are specific issues that arise for some individual consumers such as the elderly and infirm, for example, the need to visit more than one store to obtain all of the healthy basket items, or different levels of provision for certain categories or individual items. The research, however, does show quite large price differentials in terms of access to healthy food in different types of store and different socio-economic environments.

4.2 **Recommendations**

Following from the conclusions above it is recommended that:

1. Consideration be given to ways to encourage management in small general food shops to increase the range of healthy foods.
2. The survey of availability and price of healthy food, using HEISB, is extended from this pilot study to
    a. A resurvey of the existing sentinels to assess if provision is improving or deteriorating
    b. Additional sentinels be added to the existing database to enhance its coverage;
    c. A programme of rolling surveys is instituted to assess the changing levels of availability and price of healthy food in Scotland
3. Further analyses be conducted on the current data and on new data as it is acquired.
4. More detailed research, related to the costs of provision by retailers, should be undertaken to shed light on the substantial price differentials of healthy food.
5. Consideration should be given to how best to generate a regularly updated accurate spatially referenced database of food retail outlets in Scotland.