Identifying Hot Spots of Rural Resilience in Scotland

National Centre for Resilience

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NATIONAL CENTRE FOR RESILIENCE

BUILDING SCOTLAND'S RESILIENCE TO NATURAL HAZARDS

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Chapter 1

Introduction

This study seeks to create a database of resilience indicators in Scotland that can be used by community development practitioners - including local resilience groups - to support community development resilience plans and to determine a community's more or less resilience to external system shocks.

We first review how resilience has been used by different academic disciplines over time. For the purposes of this research, resilience is conceptualised through the *community* resilience paradigm. Magis'(2010) definition of resilience is used to operationalise resilience as it relates to community sustainability. This includes identifying local infrastructure that can be used by communities in the event of an emergency and infrastructure that provides some clues about a community's resilience to threats that occur more slowly, like population decline, the out-migration of people with specific strengths and qualifications and the closure or loss of important community infrastructure like primary schools and GP offices.

These places can be described in terms of community capitals, mainly built capital, which is the infrastructure within a community that supports, in part, the creation of other community capitals (Emery & Flora, 2006). Within this context, local infrastructures, like a village hall or local primary school, are indications that a community may have established other community capitals that are beneficial to resilience, mainly strong local and extra-local networks, cultural and political capital.

In addition to identifying key infrastructure that may aid in a community's resilience, we will include other indicators of community resilience having to do with social and economic paradigms. Specifically, we will re-

view and include data that measures indicators of social capital, civic engagement and the propensity of individuals to help out their neighbours in the event of an emergency. Taken together, we present a holistic approach to defining and identifying potential community resilience indicators. Our aim is not to rank communities on their resilience, rather, and following recommendations from Adekola (2018), we attempt to promote a database that can serve as a central point for public discourse on community resilience and can add to the existing information resources available to communities.

Formally, this research seeks to answer the following research question:

> What everyday resilience facilities are available to those living in rural places to aid in promoting resilient communities in Scotland; and, to what extent do emergency and everyday resilience centres exist across rural Scotland?

A key distinction that this project makes is the inclusion of two types of resilience indicators in Scotland – the *emergency* and the *everyday*. This distinction in resilience types comes from the project teams' work in resilience and key findings related to the way the Scottish Government thinks about and helps support resilience. The notion of *everyday* resilience also differs from The UN Office of Disaster Risk Reduction[1] and the Intergovernmental Panel on Climate Change's[2] definition of resilience, which both focus on the ability of a system to deal with with hazards.

We now go over the emergency and everyday resilience and discuss how we have conceptualised these in the data analysis.

1.1   Emergency resilience

Scottish Government's policy on community resilience relies heavily on emergency preparedness. A report produced by Safer Scotland (2013) de-

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[1]"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management." (UNODRR, 2017)

[2]"The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation."(IPPC, 2019)

fines community resilience as . . .

> Communities and individuals harnessing resources and expertise to help themselves prepare for, respond to and recover from emergencies, in a way that complements the work of the emergency responders. (p. 1)

The focus is on a *joined-up* approach to community resilience during times of emergency. Community members should work hand-in-hand with emergency workers to help create resilience.

Emergency resilience may be thought of as a community's resilience towards unexpected and quickly occurring shocks. Emergencies that a community needs to be resilient towards can come in many forms. Some common forms of emergencies faced by communities in Scotland are:

1. Weather & Floods

2. Natural & Environmental hazards

3. Terrorism

We now briefly review each of these categories of emergency resilience threats before moving on to the everyday resilience threats. Please visit Ready Scotland's website (www.readyscotland.org) for information and advice on threats to emergency resilience.

1.1.1　Weather & Floods

Severe weather conditions and storms can hit Scotland and cause damage to communication lines, transport routes and structures within the community. Scotland is prone to severe wind year-round and receives winter storms which can bring ice and snow. Scotland also has hot days in the summer. Whilst weather forecasting services can identify coming storms and provide some warning, bad weather can strike unexpectedly and be more severe than originally anticipated.

Flooding is a common problem in the UK, and is often caused by torrential rainfall. Weather services are able to predict rainfall in areas fairly accurately and provide warnings. However, predicting the specific location and level of flooding that results is often harder to do. Flooded areas in rural and remote Scotland can find themselves further cut off from urban places. Roads and highways can become impassable when covered by

water. This is particularly dangerous when water is moving over roads as cars can be carried off the road by a relatively small amount of water.

A particularly bad and recent winter storm to hit Scotland was in February 2018 (known as *The Beast from the East*). The Beast from the East caused a great deal of damage to large parts of the country. Rural and remote areas where impacted particularly bad, with high snow causing road closures and wind that caused ferries to remain in port. Farmers were hit particularly bad during this storm. Livestock became trapped by snow and cleanup on the farms went on weeks after the storm ended. There were instances when fencing was damaged and sheep and cows became lost.

The Beast from the East is also an example of innovative ways that communities can be resilient. There were many instances when people in rural areas came to the aid of the neighbours. Ad hoc transportation hubs were setup by locals who realised that many in the community might not have access to cars or trucks. Farmers and others with large equipment and access to diggers helped clear and open roads.

1.1.2   Natural & Environmental Hazards

Natural hazards represent "the *potential* [added] interaction between humans and extreme natural events" (Montz, Tobin, & Hagelman, 2017). Natural hazards are distinct from weather-related emergencies as they are not caused by weather-related events or are much more uncommon and are much more difficult to forecast. Natural hazards can include things like earthquakes and tsunamis. Scotland, and the wider UK, has been hit by hurricanes or cyclones in past, has suffered from long periods of drought (e.g. Summer 2018) and experiences wild fires that cause much destruction in rural and remote areas.

Environmental hazards are emergencies caused by people that negatively impact the environment. Rural and remote places in Scotland are often tied to their environment economically. Therefore, environmental hazards are often long-felt in rural and remote places after they have occurred.

Often, a threat to environmental resilience is man-made or anthropogenic. A common example of this is an oil-spill. Offshore oil spills are particularly impactful in Scotland given the number of offshore oil rigs in operation that are only a short distance from the shoreline. One infamous oil spill happened in Shetland in the early 1990's when an oil tanker ran

ashore. The oil spill was disastrous for local wildlife, especially local bird populations. While this type of disaster is rare, having a strong core of local volunteers on call when it does happen is one way to ensure local areas are resilient when it does happen.

1.1.3 Terrorism

Another type of emergency resilience pertains to acts of terrorism. Terrorism is rare, but can come in different formats. Firearms and weapons attacks are examples of terrorism. Communities are becoming more resilient to acts of terrorism through planning and preparedness.

1.2 Everyday resilience

Ongoing research by project team members[3] and others into the nature of rural resilience in Scotland has revealed a new conception of resilience, termed *everyday* resilience. Ongoing research as apart of the *Local Assets, Local Decisions and Community Resilience* project funded by RESAS, looks into the nature of rural resilience in Scotland. The notion of everyday resilience has emerged over the course of this research as an area of resilience that is fundamentally different to emergency resilience (Currie, 2019), deserving of equal attention this study of resilience indicators.

Rural communities in Scotland face unique challenges around sparseness and declining population, and rural areas are becoming older (Hopkins & Copus, 2018), which also brings unique challenges to resilience. Formally, everyday resilience is defined as

> . . . the ability of a rural community to survive long-term and gradual decline that affects everyday rural life (e.g. the closure of key services and facilities, demographic ageing, etc.); as well as communities having the ability to move forward to create a new milieu, and recognising that this process involves both human agency and available assets (i.e. both physical and social capital). (Currie et al., 2019, p. 1)

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[3]Project team members Elliot Meador and Mags Currie are both apart of the Scottish Government Rural Affairs and Environment Portfolio Strategic Research Programme 2016-2021, Theme: Food, Health and Wellbeing, RD 3.4.4 Local Assets, Local Decisions and Community Resilience.

Everyday resilience is differentiated from emergency resilience because it happens much slower. It can be hard to see happening; sometimes decades can pass before it is obvious. Threats to everyday resilience may come in the form of slow but steady population decline from out-migration of local residents. Other threats to the everyday resilience are having a low level of local civic engagement. Civic engagement can be seen in things like high numbers of volunteers and organisations that promote collective action in local places. These types of organisations are often quite useful in ensuring resilience to emergency threats, but they are also often a good indicator of overall community social health.

1.2.1   What does everyday resilience look like?

Everyday resilience is associated with civic engagement and social capital. Traditionally within academic literature, civic engagement and social capital are represented in infrastructure that promotes local collective action efforts. In many ways, these types of structures align closely with the Scottish Government's notion of community resilience that is heavily reliant upon a joined-up approach. For instance, a local community centre may be considered a strong indicator of an area's everyday resilience. However, in the case of emergencies, it could also be highly likely that that same community centre is utilised to organise the different teams of people who come in to help. In this since, a community centre can serve dual resilience purposes: community centres can promote everyday resilience, in the sense that it is a source of collective action and social capital; and community centres can promote emergency resilience, in the sense that it supports local organisational efforts during times of emergencies.

It is therefore worth discovering and identifying both the everday and emergency resilience indicators. Furthermore, identifying the extent to which they overlap in rural areas is worthwhile knowledge. Communities with limited resources can use this knowledge to help quickly identify local meeting places for resilience planning exercises. The following chapters of this report outline the research undertaken to identify and map the everday and emergency indicators in Scotland using novel approaches to data collection and analysis. We now move on to discussing the background on resilience as it relates to everday and emergency resilience before reviewing the research methods and case study results.

Chapter 2

Background on Resilience

This chapter will review the concept and history of community resilience. We also discuss resilience from a policy perspective in Scotland. Resilience, as an academic pursuit, has a long history. Its usage can be traced back several In order to accurately cover the critical components of resilience as it relates to rural communities in Scotland, we will:

1. Review resilience in the wider academic literature – including a very short epistemological overview of resilience found in Alexander (2013);

2. Look at resilience in the ecological sciences – mainly looking at work by (Holling, 1973);

3. Go over resilience in the community and rural development literature – paying specific attention to the economic and social implications of resilience, looking at work by Putnam (2001), Granovetter (1977) and Coleman (1988);

4. Discuss resilience as it relates specifically to infrastructure and built capital, based on Emery and Flora (2006); and,

5. Review current policies on resilience in Scotland.

2.1   Resilience in Academic Literature

The concept of resilience in academic literature has a long history, and its usage as a theoretical construct spans many different disciplines. The study of resilience in this project can be classified as community resilience.

Researchers who study community resilience usually do so by way of a theoretical lineage that comes from the ecological sciences. However, resilience has a much deeper history, and it is worth spending a bit of time looking at this.

Alexander (2013) provides an excellent epistemological review of resilience and traces it back as far as Sir Frances Bacon's use of the term in the 16th century. Resilience use grows rapidly after Holling's paper, *Resilience and Stability of Ecological Systems*, is published in in 1973. After this, resilience starts to become a popular theoretical pursuit in the social sciences, moving between anthropology, child psychology and social research in general. Community and rural resilience emerge in the literature after the 1990's. Community resilience becomes popular following the huge growth in the idea of *social capital*, in the early to mid-1990's. As we will see later, community resilience is highly influenced by the idea of social capital and includes social relationships as a mainstay.

An adaptation of Alexander (2013)'s schematic illustration of resilience is shown in Figure 2.1.

2.1.1   Origins & Roots in Ecology

Holling (1973) popularised the term *resilience* in his now-famous[1] paper, *Resilience and Stability of Ecological Systems* in the early 1970's. Resilience as a concept is separated from the notion of *stability*, which Holling (1973), refers to as the "... ability of a system to return to an equilibrium state after a temporary disturbance. (p. 14)" Stability is often referred to as a system's ability to bounce-back after some type of shock.

Shock can take on many different types of meanings depending on the discipline of study. Ecological systems might experience a system shock in the form of the arrival of some new pest. For instance, the plant pathogen *xylella* has the potential to infect a wide range of host species and cause significant damage to organisms it infects. Whilst xylella has not yet been found in the UK, its introduction is likely imminent (Mabbett, 2018). Ecological systems in the UK that are impacted by xylella and are able to bounce back or return to a state resembling that of before the pathogen's introduction would be considered highly stable systems.

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[1]As of this report's publication Holling's (1973) paper has over 13,000 citations according to Google Scholar.
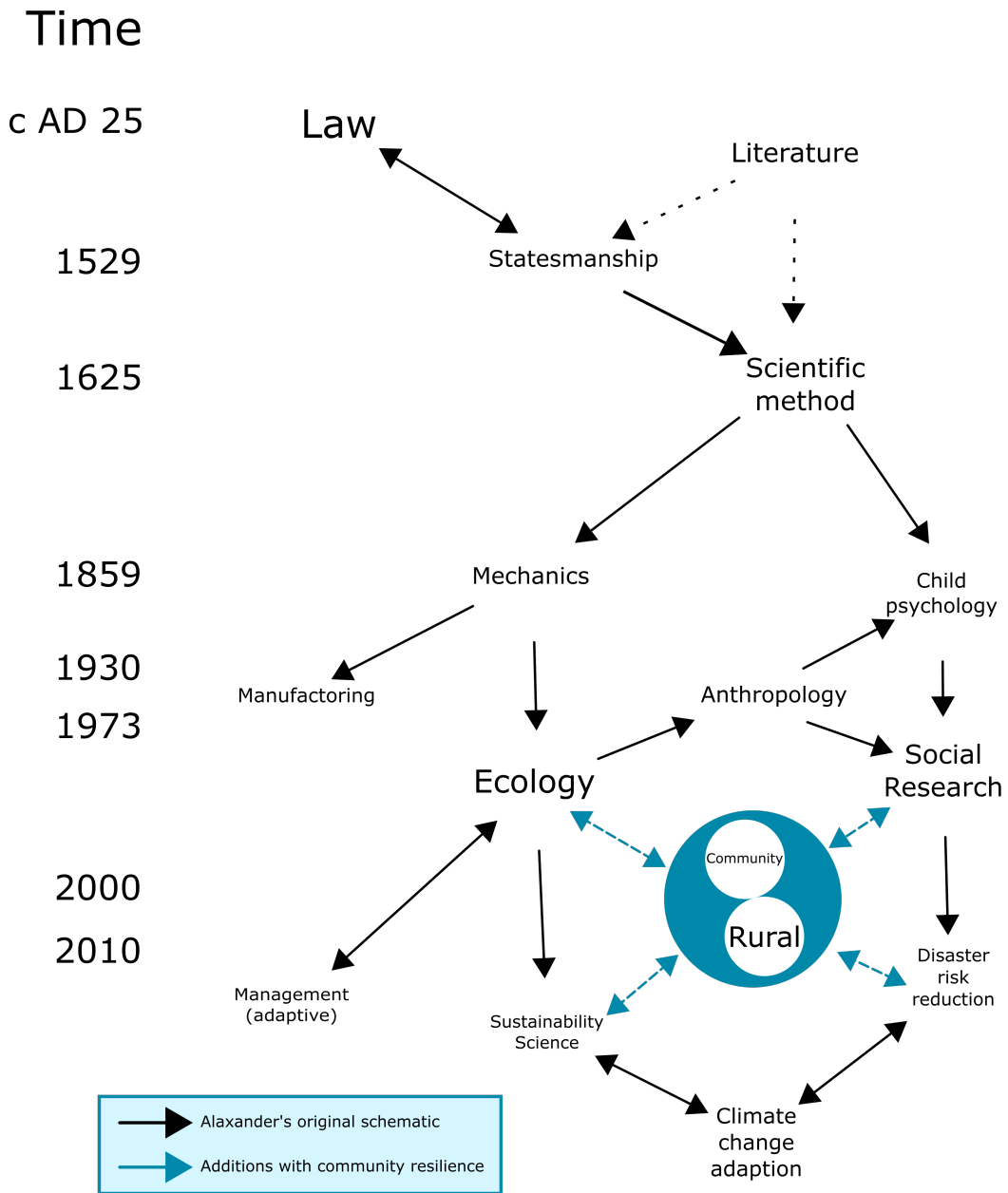
Figure 2.1: Adaption of Alexander's (2013) schematic overview of resilience in academic literature

Holling (1973) identifies resilience as something separate but similar to stability. Resilience may be thought of as the relationships or connections between nodes or actors in a system. These relationships are their ability to remain cohesive in times of strain are what makes a system resilient. He states:

> But there is another property, termed resilience, that is a measure of the persistence of systems and of their ability to absorb change and disturbance and **still maintain the same relationships between populations** [*emphasis added*] or state variables. (p. 14)

2.2   Social & Economic Resilience

Magis (2010) points to the importance of operationalising community resilience in a way that is Mainly, studies on community resilience can be used to "...develop community resilience, guide policy development, and provide vital criteria to evaluate policies and practice" (p. 412).

Within Magis' (2010) framework, we now present the current literature on community resilience from an economic and social perspective. Steiner and Markantoni (2013) suggest a model of community resilience in Southwest Scotland that includes components of community versus individual social and economic resilience.

Practical applications of this model found that while both community and individual social and economic resilience is important for communities who engage in development programmes, social characteristics (such as the ability to work together to solve problems) was a better indicator of overall community resilience than are indicators dealing with economics (Markantoni, Steiner, Meador, & Farmer, 2018a). Often, the indicators of social resilience used by Markantoni et al. (2018a) were analogous to traditional indicators of social capital. The theme of social capital can be found throughout much of the literature on community resilience (Emery & Flora, 2006; Magis, 2010; Aldrich & Meyer, 2015).

Social capital can be thought of as reciprocal trust that exists between actors in a community or social system (Putnam, 2001). There are two kinds of social capital that are particularly beneficial to rural communities – bridging social capital and bonding social capital. Bridging social capital may be thought of as the creation of new social ties whilst bonding social capital can be thought of as the strengthening of existing social ties

(Woolcock & Narayan, 2000). Social networks can be thought of as the identifiable linkages that people within communities have to one another that are beneficial in times of emergency and in community development efforts. Meador (2019) looked at the influence of social networks between community development boards and found that organisations with better connected board members tended to do better and were more resilient.

2.2.1   Resilience in Built Capital

As mentioned above, built capital is one of the community capitals identified in the community capitals framework (Emery & Flora, 2006). From a community resilience perspective, built capital can serve as a place for people to meet to receive information and supplies during an emergency, but it also serves as an indicator of resilience to population decline and other long-term threats communities may face. In this sense, they are dual-purpose resilient indicators for both the short – and long – term resilience threats. Other researchers have created robust models of national resilience using access to built capital as indicators of community resilience. We now review one such model introduced in Cutter et al. (2014) and applied in a rural-urban context in Cutter et al. (2016), henceforth called the *Cutter model*. The Cutter model uses secondary data sources from a variety of (mostly) open-sourced and publicly available datasets to create a model of county-level resilience in the U.S. The model includes categories of variables, with indicators which help to frame each category.

1. Social – 9 indicators

2. Housing & Infrastructure – 10 indicators

3. Community Capital – 7 indicators

4. Economic – 8 indicators

5. Institutional – 10 indicators

6. Environmental – 5 indicators

The Cutter model works by taking county-level data for each category and indicator listed above, transforming some indicators to percentages when appropriate, normalising data that did not undergo transformations and summing each category. The results were then mapped to U.S. counties. In Cutter et al. (2016) – a follow-up paper using different data, but very similar approaches to those used earlier – the same researchers found that

there are key differences in resilience between rural and urban areas in U.S. counties. According to Cutter,

> . . . community capital and the environmental subindex were the main drivers of rural resilience, whereas the economic, institutional, infrastructural, and social subindexes were the drivers of urban resilience. (Cutter et al., 2016, p. 14)

This supports findings from research undertaken in Scotland; mainly, Markantoni et al. (2018b), who found that social resilience indicators in rural areas of Dumfries and Galloway were more important to community success than where economic indicators.

2.3   Resilience in Scottish Policy

Formal resilience structures in Scotland operate nationally, regionally and locally. Nationally, the Scottish Government's Resilience Division works with organisations across Scotland to plan for and coordinate responses to emergencies. The Scottish Government Resilience Room (SGoRR) operates like COBRA and functions to brief ministers and coordinate responses to major incidents. Ready Scotland is the public-facing side of national resilience work, providing advice to individuals, businesses and communities about preparing for crises such as severe weather, terrorism and digital threats, while Scottish Resilience Development Service provides multi-agency training to build resilience capacity across Scotland.

Regionally, there are three Regional Resilience Partnerships (RRPs) covering north, east and west Scotland, which are legislated for through the Civil Contingencies Act 2004. Each RRP is chaired by an Assistant Chief Constable, with representation from leaders of partner organisations, primarily Category 1 responders (emergency services, local authorities and the NHS).

While the focus of RRPs is largely on resilience planning, Scotland's 12 Local Resilience Partnerships (LRPs) have a narrower geographical focus and a more operational and tactical role. RRPs and LRPs follow the Integrated Emergency Management protocol, which involves assessment of risks, mitigation of risks where possible, planning, responding and finally recovering.

At the community level, there are around 300 resilience groups in Scotland, usually but not always based around community council areas. Generally these focus on developing the skills and resources available within communities so that they can help themselves immediately and effectively in the event of an incident, rather than wait for the emergency services to arrive. Participants noted an uneven spread of these groups across Scotland. There are large numbers of active resilience groups in the Scottish Borders, Dumfries and Galloway, and Perth and Kinross, for example, and fewer in Aberdeenshire, Highland council and the island groups.

To conclude, the term *resilience* is multifaceted. Its use in an academic sense spans centuries. However, community and rural resilience is relatively new, with most of the academic literature on the subject having been published in the last two decades. For the purposes of this study, resilience is conceptualised into to broad categories: *everyday* and the *emergency* resilience.

In the next chapter we look at the research methods used to investigate everyday and emergency resilience in Scotland.

Chapter 3

Research Methods

3.1 Using an Iterative Approach

This study uses a mixed-methods approach to classifying rural community resilience and identifying appropriate indicators of rural resilience in existing data. Research is broken into two separate but iterative work packages. First, qualitative data was collected in the form of key-informant interviews with key stakeholders in areas of resilience planning from different groups in Scotland. One purpose of these interviews is to map how local stakeholders groups in Scotland identify, define and conceptualise resilience. In addition, these interviews helped inform the identification and categorisation of potential resilience indicators in the secondary databases used in the research.

The qualitative and quantitative data collection and analysis were iterative in nature. Findings from key-informant interviews was shared with researchers working in the quantified components and discussions were had about which types of structures should be included and excluded in the database. Likewise, findings from the quantitative components were shared and discussed with researchers conducting the key-informant interviews. This process repeated throughout data collection. It proved to be a useful approach to gather evidence on resilience indicators that were ground-truthed in real time with experts in Scotland.

> In subsequent paragraphs we frequently refer to related but different concepts of the study process and results – resilience *indicators* and resilience *resilience infrastructure*. Going forward, it is useful to quickly define these concepts. They can be defined in the following ways:
>
> 1. **Resilience indicators** – the *categories* of resilience structures that are used to identify resilient areas in Scotland. We argue that places that are highly resilient often have a high number of resilient indicators within close proximity to their location. Resilience indicators come from discussions with key-informant interviews.
> 2. **Resilience infrastructure** – the *structures* identified within the The Points of Interest© database that correspond to each resilience indicator.

3.2   Secondary Data Sources

A unique approach is used to identify and classify potential resilience indicators in Scotland. The Points of Interest© database list all places in the UK that have an address, and data mining, guided by key-informant interviews, is used to pull the relative points of interest from this database. The distance for all post codes in Scotland to each point is calculated, and the shortest distance for all datazones is calculated by taking the average. The resulting database can be used to identify areas in Scotland that have relatively high or low access to resilience indicators.

This approach is useful in identifying areas of resilience based on access to potential resilience infrastructure. However, as is discussed previously, community resilience is about more than infrastructure. Social relationships and the propensity to help one's neighbour are important components of resilient communities. In addition, things like having access to a car and the overall demographics of local populations would also influence community resilience. Therefore, in order to account for these, the findings from the Points of Interest© analysis will be merged with findings from the analysis of public databases that capture other aspects of community resilience (i.e. local levels of social capital). In order to capture these variables, analysis using the following databases will be included:

1. Scottish Census (2011)

2. Scottish Household Survey (2016)

3. Scottish Health Survey (2016)

4. Scottish Index of Multiple Deprivation (SIMD) (2016)

In the following sections we review the approach to analysis for each database. This includes a review of the variables used and the reasoning for including them and the lowest geography used.

3.2.1   Points of Interest

The Points of Interest$^©$ database is a proprietary database of all businesses (both publicly and privately owned). It includes location data, in the form of national grid coordinate references for all places listed. In addition, it has a variety of categorical data on each point. Each location has a:

1. Name

   (a) This includes the full name of the business or organisation. This data is useful for text mining to help determine exactly what type of location it is.

2. Post code

   (a) Postcodes are provided when available

   (b) Postcode areas (2-digit format – EH for Edinburgh) are most common, and some postcode sectors (6-digits) are available

3. Points of Interest$^©$ Classification

   (a) This classification is created by PointX

   (b) There are three levels of classification that are hierarchical known as Level 1, Level 2 and Level 3

   (c) Level 3 is the most comprehensive with over 600 different classifications

4. Standard Industrial Classification (SIC) codes

   (a) A SIC code is a type of company code, and there are about 700 different SIC code classifications.

   (b) SIC codes help identify and classify businesses based on the type of product they produce or service they provide.

   (c) SIC codes are identified by the business or service.

(d) It is possible for businesses or services to have more than one SIC code and this is reflected in the database. All points included in the database included at least one SIC code and about thirty percent had at least two. This percentage of businesses that have three or more SIC codes is very low. Therefore, we only used the first or second SIC codes if it was available.

Measuring the distance to resilience infrastructure

Understanding how far communities are from resilience infrastructure is important to understand how well areas are served. Similar to using a mapping app to find the shortest path from our location to the nearest restaurant or train station, in this analysis we look at the nearest distance between every Scottish postcode and each type of resilience infrastructure. To do this, we analysed the geographic network of roads to calculate the nearest resilience infrastructure to each Scottish postcode. Postcodes are used as a proxy for people, though not all will have residents. Nearly all postcodes will have had people within their boundary at some time. so they are a valuable identity as an origin for a journey. Running our analysis at a postcode level avoids us being confined by geographic boundaries, which means our results can be aligned to any required reporting level (e.g. datazones or local authorities).

We have used GRASS GIS for our network analysis and R to manage workflows (Spencer, 2019). The datasets used are:

1. Ordnance Survey code-point open (postcodes)

2. Ordnance Survey openroads

3. Ordnance Survey/PointX Points of Interest

The openroads dataset does not include ferry lines, so results are contained to each island, i.e. if there is no resilience centre on the island there is no path to it.

The results of this analysis are available in a geopackage database (Spencer, Meador, & Wilson, 2019).

3.2.2   Scottish Census 2011

The Scottish Census contains useful information pertaining to community resilience that is included in the database and analysis. The census is a particularly good dataset as it does not utilise a sample. Rather, the census includes nearly all records, thus ensuring that a fine level of detail is available. Furthermore, the Scottish Census has accurate data for data-zone level geography. The drawback to this is that the Scottish Census only occurs once every decade, meaning that the current data is now close to 10 years old. In certain instances it is possible to determine the accuracy for some items using data from the Scottish Index of Multiple Deprivation (SIMD).

The SIMD is a ranking indicator that is created from many different variables and databases in Scotland. It is a tool used by the Scottish Government and many other agencies to identify deprivation in Scotland. It is comprised of seven domains and over thirty indicators. Whilst the SIMD will not be used directly in the database, it will be used to gauge the accuracy of some Census variables. The following variables from the Scottish Census are included:

1. Proportion of the population that has access to a car or van by age

2. Proportion of the population that has access to a car or van by occupation

3. Proportion of the population that has access to a car or van by place of work

The variables above will help identify areas in Scotland where people are more likely to have access to personal vehicles. These variables are available in table format, and they can be crosstabulated for other variables of interest, like age. This is a very useful approach to identifying areas of resilience given the changing demographics of rural and remote places in Scotland. These areas are seeing increasing numbers of older people who live alone, and those without access to personal transportation could be in a vulnerable situation.

3.2.3   Scottish Household Survey

The Scottish Household Survey (SHS) is a biennial survey that is conducted by the Scottish Government. The SHS provides useful data on the

measures of social capital and indicators of helpfullness in the event of a disaster. The SHS has a sample size of about 10,000 respondents. The sample is representative of the geography of people in Scotland – more people are sampled in urban areas and fewer people are sampled in rural and remote areas. The following indicators are used from the SHS:

1. Social capital indicators

    (a) Rate your neighbourhood

    (b) Feel like you belong in your neighbourhood

    (c) Neighbourhood is better/worse over time

    (d) Can go to your neighbours for advice

2. Emergency action indicators

    (a) Rely on neighbours in emergency

    (b) Help neighbours in event of emergency

These indicators have been added to the database and will be used to examine the impact that social capital and neighbourhood relationships have on resilience. Data is aggregated at the level of local authority level. This ensures that rural places have enough representation that the required minimum statistical power can be met. The mean score for each local authority can be found in the database and will be included in subsequent analysis in later chapters.

3.3   Identifying Resilience Indicators

Resilience indicators are identified in the Points of Interest$^{©}$ database by a variety of text mining approaches. In this section we introduce the approach used to identify and categories resilience indicators. The process of identification relies heavily on qualitative data that was gathered through key-informant interviews (*see* Section 3.1, p. 18).

A text mining approach was adapted to help search the database's list of place names to provide evidence on which categories to include. Text mining can be thought of as the process of gathering data from unstructured formats (Feldman & Sanger, 2007). The *name* column in the database can be considered unstructured data because that text data can be analysed, using text mining approaches, in ways the other columns cannot. N-gram

analysis, which is the process of creating networks from word pairings (Silge & Robinson, 2017), is used to help identify which pairs of words appeared in key categories. Examples of findings from n-gram analysis for each category is provided in Chapter 5 (starting on page 31).

Chapter 4

Stakeholder Perspectives

4.1 Key-Informant Interviews

Dr Ruth Wilson conducted interviews with 18 participants between May and July 2019. In selecting participants, we aimed for:

1. Geographical spread across rural Scotland

2. A range of *rurals*, spanning classes 4-6 of the Scottish Government's 6-fold Urban-Rural Classification: remote small towns, accessible rural and remote rural

3. A mix of island, coastal and inland locations

4. Participants involved in resilience activities at a range of scales (national, regional and local)

Participants included representatives from the Regional and Local Resilience Partnerships; "local" representatives were generally in post in local authorities. In addition, participants from six rural communities, who had some involvement in community resilience activities, were interviewed about their views and experiences.

As participants were distributed across Scotland, most interviews were conducted by phone.

Participants were primarily identified by "snowballing", with representatives from Regional Resilience Partnerships suggesting individuals in Local Resilience Partnerships, and those individuals in turn suggesting communities with active resilience groups. As such, most of the individuals

interviewed were part of a Scottish resilience "network", whether formally or informally. This has implications for interpreting the findings from this project: all interviewees were active in the area of resilience and many (but not all) shared views of what resilience is, often deriving from the Civil Contingencies Act 2004, which forms the basis of formal resilience structures in Scotland (see section 3). Having said that, participants were generally keen to reflect on resilience as a concept more broadly and how the term is applied in other contexts.

Participants were provided with an information sheet about the project via email in advance of the interview. In addition to being asked about places that can help communities to be resilient, they were asked about:

1. Their own understanding of resilience

2. What makes rural communities resilient

3. Whether they think their community (or communities in their area) is resilient – compared to other communities, and compared to the past

Interviews generally lasted between 30 and 60 minutes.

During the interviews, participants were asked about the kinds of places and facilities that can help to make communities more resilient, in their experience. They mentioned the following amenities, which informed the creation of the resilience map:

1. Village halls and community centres

2. Hospitals

3. Police stations

4. Fire and rescue service

5. Ambulance services

6. First Responders

7. Maritime and Coastguard Agency – lifeboats and lifeboat sheds

8. Air ambulance

9. Doctor's surgeries

Of these, village halls and community centres are generally the places around which community resilience activities are focused, although not all such places are used for these purposes, and some have been fitted out

to a greater extent than others with facilities and equipment intended for use in emergency scenarios.

It is important to note that community spaces that are being appropriated for resilience purposes are not always based in village halls or community centres, with some participants mentioning the use of sports centres, church halls and farm or estate buildings. However, these facilities did not seem to be used consistently for this purpose, and so have been excluded from the above list. The same applies to schools, which were infrequently mentioned by participants as designated points of resilience, since access can be restricted during times of teaching and exams.

Participants did not necessarily expect the other amenities on the list to be located in their own communities but rather within close enough reach so that their associated services could be drawn on quickly if needed.

Additionally, participants mentioned assets that they associate with resilience that were not within the scope of this project to identify and map. These included generators, 4-wheel drives, tractors, chainsaws, defibrillators, snowploughs and satellite phones, which would generally be itemised in community asset registers.

During the interviews, we also asked participants about resilience more generally.

4.1.1   Defining Resilience

Most participants talked about resilience in the context of emergency planning and civil contingencies. This was by virtue of the fact that the selected participants were generally part of Scotland's formalised resilience structure that stems from the Civil Contingencies Act 2004, and which provides an implicit vocabulary for discussing resilience that is now well embedded in the public sector. Within this understanding of resilience, participants talked less about "bouncing back" and recovery from incidents, and more about having a plan in place should things go wrong and mitigating risks ("preventing what could happen"). The required response to an emergency depends on the type of emergency, what area it affects and when it occurs. In this sense, resilience is widely understood to be about knowledge of available assets and working together, particularly with respect to cooperation between the different sectors (voluntary, public and private) and key organisations so that "the right people [are] round the right table

at the right time". This involves joint meetings, joint training, maintaining lists of assets, and having arrangements in place for responding to events when they occur. As such, resilience for the participants was more about knowledge, public engagement and ways of working together and less about where physical facilities are located.

When probed about what makes some communities more resilient than others, participants gave more reflective responses that hinted at under-pinning characteristics of resilience that are arguably deeper and can be applied more widely than in emergency situations. Several described resilience as starting with individuals, their capabilities and attitudes to life: if individuals are independent and motivated to improve their lives, then this can become the basis of resilient communities. Indeed, one stake-holder from a remote rural development group described encouraging this capacity ("enabling people and communities to help themselves") as key to developing the resilience to withstand the variety of challenges that a remote community faces, such as a lack of public services and the threat of market failure. This can be a broad undertaking, about addressing issues of mental and physical well-being in areas where isolation and poverty are common, as well as providing sustainable, community-led solutions to economic and infrastructural challenges.

A couple of participants referred directly to the sustainability of the population as a key part of the resilience equation: planning for and responding to events requires sufficient people with the right skills. Recent population projections are recognised as a concern, as is the withdrawal of EU migrants.

4.1.2   Who's Involved with Resilience

Participants reported that many of the communities that draw up emergency plans do so following an emergency. Typically, these include incidents of flooding, power outages or road closures that leave communities cut off for a period of time. While some communities are continuing to build on and develop their plans and their ability to respond to such events in the future, others seem to lose momentum after the initial plan is drawn up.

During the interviews, it became apparent that community resilience groups sometimes draw on the skills of retired emergency service workers, who are well placed to make resilience plans. Their work, and that of other vol-

unteers, was mentioned often as critical to the resilience of communities. Several participants observed within their own groups a high proportion of people who had moved to the area, and fewer people who had lived in the community all their life. This warrants further investigation to understand the extent of differing levels of engagement within communities, the reasons behind them and the implications for resilience planning.

Community councils are a key channel for Local Resilience Partnerships to communicate with local residents, and a degree of resistance was noted among community council members in some areas who consider resilience planning to be the work of the local authority. Local Resilience Partnerships were continuing to promote available support to these communities on the grounds that other local residents may see the benefits.

4.1.3   Measuring Resilience

For many of the participants, resilience is a nebulous concept that is difficult to define and therefore to measure. In particular, our project's approach of focusing on physical assets was highlighted as a concern, since physical infrastructure is just one aspect of resilience and a greater density of village halls and hospitals does not necessarily equate to a more resilient place. Whether facilities contribute to a community's resilience depends largely on the people available to use and service them but also on their opening hours, which vary across rural Scotland. Likewise, the absence of a nearby facility does not necessarily suggest less resilience if the facility can reach or be reached by the community when it is needed. One participant gave the example of Police Scotland, which has one helicopter based in Glasgow for responding to emergencies, which does not make for mapping in any meaningful way. Furthermore, access to facilities is often dependent on infrastructure and, if a main road closes, this can cause the facility to become unavailable.

In addition, communities face different levels and varieties of risk that arguably mean they need different facilities and measures in place to deal with potential incidents. For example, an area with an oil depot or naval base will have to factor into their plans the potential wide-scale impact of any local incidents and plan for an intensive, large-scale response. Therefore, the same facilities in two different places does not necessarily mean equal levels of resilience, since the threats to one community may be far greater. To complicate matters further, risk levels can vary at different

times, for example holidaymakers can increase the pressure on infrastructure and resources in rural areas, making a rural area more vulnerable to certain kinds of incident during the summer months.

4.2   Rurality & Resilience

Participants noted that formal resilience groups are mostly in accessible rural regions. There was a common perception that remote rural communities, and islands in particular, have fewer resilience groups because they are historically well used to coping with power outages, road closures and ferry cancellations, for example, and often have processes in place for preparing for and responding to such situations which, although they may not be formalised, are embedded in the way of life. A few participants noted that we should not assume that this is the case, however. Given the diversity of remote rural communities across Scotland, their different geographies, demographies and histories, there may be other reasons behind remote communities' relative lack of engagement with resilience initiatives. Some remote communities are much better placed to respond to adverse events than others.

Urban areas, on the other hand, often do not have resilience groups because they tend to . . .

1. Be better connected to services, resulting in less perceived need among residents

2. Their communities are, by definition, more highly populated and can be amorphous, meaning that there is less of a tendency for individuals to form place-based community groups

Several participants highlighted that urban areas would nonetheless benefit from making resilience plans, as they are no less susceptible to various risks, with the fire of Grenfell Tower cited as a recent example of an urban emergency that would have benefited from community-level resilience planning.

Many accessible rural areas, with lower populations and more definable communities, a number of which have recently experienced weather-related emergencies, such as flooding and heavy snowfall caused by the Beast from the East, seem to be well attuned to the value of forming community resilience groups.

Chapter 5

Resilience Identifiers

This chapter reviews the findings from the resilience indicators analysis. General findings related to the types of categories and general themes are first presented. Following this, community resilience indicators are reviewed in special detail. This is due to the complex nature of community resilience indicators, and their ability to span many different categories. Then, a review of statistical findings regarding the spread of indicators across the rural–urban geographical continuum is provided. Lastly, an overview of resilience relating to social capital and personal assets is provided.

There are sixteen resilience sub-categories that emerge, including indicators for both emergency and everyday resilience. The resilience indicators are shown in Table 5.1. Indicators span a variety of topic areas. Broadly, there are two themes that emerge in the indicators list that stem from the emergency resilience indicators – *rescue* and *medical*.

1. Everyday resilience indicators

   (a) Community halls & centres

   (b) Sports halls, pubs & inns

   (c) Schools & nurseries

   (d) Community network organisations

2. Emergency resilience indicators

   (a) Rescue services

      i. Fire & police services

Table 5.1: Resilience indicators by category

Resilience category	Total places	Percent of total
Pubs, bars and inns	3,516	20.0%
Gymnasiums, sports halls and leisure centres	3,060	17.4%
Halls and community centres	2,240	12.7%
First, primary and infant schools	2,003	11.4%
Nursery schools and pre and after school care	1,455	8.3%
Chemists and pharmacies	1,231	7.0%
Doctors surgeries	1,085	6.2%
Clinics and health centres	854	4.8%
Special purpose machinery and equipment	440	2.5%
Coastal safety	366	2.1%
Fire Brigade Stations	337	1.9%
Community networks and projects	312	1.8%
Police stations	284	1.6%
Mental health centres and practitioners	276	1.6%
Ambulance and medical transportation services	131	0.7%
Helipads	33	0.2%

[a] There are 17,623 different locations in the database

     ii. Helipad

    iii. Coastal emergency services

    iv. Special machinery

  (b) Medical services

     i. Chemist, doctors & health clinics

    ii. Mental health centres

    iii. Ambulance

5.1   Community Centres

The indicator of community centres and village halls deserves special attention due to the uniqueness of community centres as a source of everyday resilience in the database. Community centres are a place for local

communities to meet, hold events or do a variety of activities that generally support the creation of social capital and civic engagement. Many times, a thriving local community centre is symbolic of a healthy community, and community centres can invoke thoughts of collective action. Very generally, the presence of a community centre would suggest a local area is resilient, at least from the perspective of the *everyday* resilience (due, in part, to the relationship between social capital and everyday resilience).

Community centres come in a variety of styles, and it can be exceptionally difficult to differentiate one from the other. Some community centres are one-room buildings that have been built specifically for one purpose – to be the local community centre. Other community centres exist within larger building structures, maybe as part of sports complex or a secondary school. It is quite common for community centres to be associated with centres of worship, and they can often be found occupying old religious buildings.

It is possible to get a deeper understanding of this by analysing the composition of words in the names of community centres. This process is called n-gram analysis.

5.1.1   What's in a name?

The n-gram analysis performed on all places categorised as community centres in the database is presented in Figure 5.1. The abundance of religious centres in the names of community centres is clearly shown. Furthermore, there appears to be a few places with names that include the words: education, resource and learning. Whilst it is outwith the scope of this research, this finding deserves further investigation as it allows for the further refinement of the community category into more meaningful subcategories.

The community category includes just over 2,500 places, which are split between two sub categories – Community Networks & Projects and Halls & Community Centres. There is a high variability in the types of names and places in the community category. It includes a great deal of overlap with places of worship, especially churches and parishes, though the majority of community places appear to be owned and/or operated by local communities and are not associated with places of faith. The word pairing "Community - Hall" appears 838 times in this category. Making it nearly twice as prevalent as the second highest word pairing, "Church - Hall",
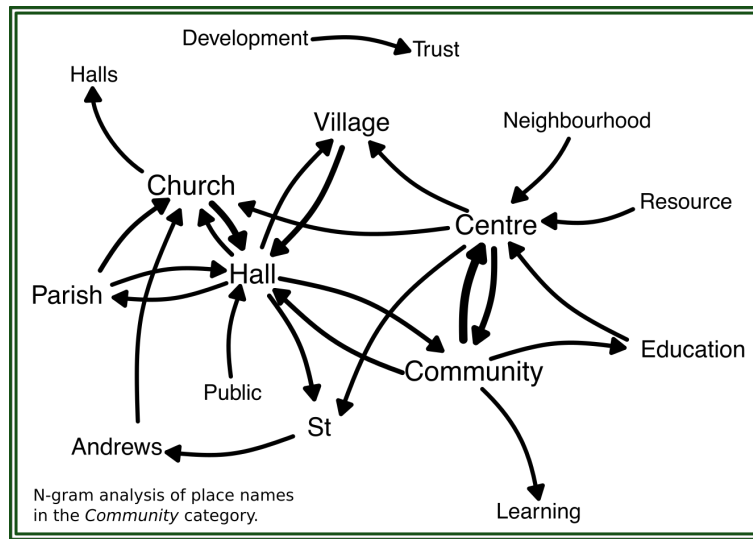
Figure 5.1: Most popular word pairings in the Community resilience indicators category

which appears 478 times.

5.1.2   Community centres across Scotland

Community centres are well-represented across Scotland. Whilst the distribution of community centres across Scotland follows closely with a general population map (*see the Central Belt*), community centres can be found in rural and remote places in Scotland as well as in many islands. A map of the approximate locations of all community resilience indicators is shown in Figure 5.2.

5.2   Emergency resilience

As mentioned above, two separate but somewhat overlapping sub-categories of emergency resilience indicators emerged in the findings – rescue and medical services. We now discuss these two sub-categories of resilience indicators separately starting with rescue services, then moving to medical services.
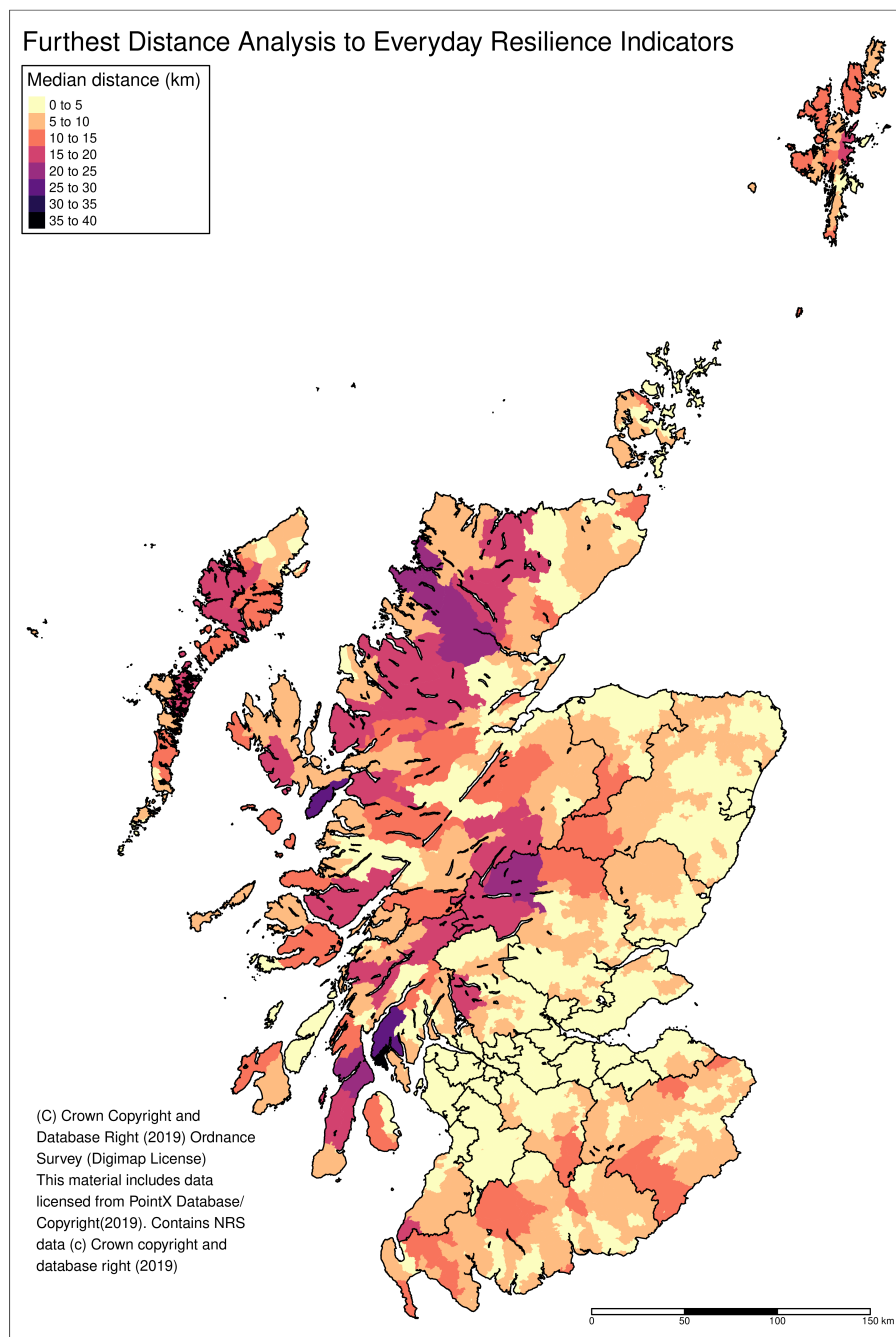
Figure 5.2: Approximate locations of places within the community resilience category in the resilience indicators database

5.2.1   Rescue services

Emergency rescue services are those services that communities may require in time of emergencies. As previously mentioned, the is a wide range of potential emergencies that communities may face in Scotland. This is captured in the interview responses, which make specific mention of fire, police and ambulance services. Another service that was explicitly mentioned in the stakeholder interviews is that of helipads and places to obtain special machinery. In addition, given Scotland's geography, with a large number of islands and coastal area, participants noted that coastal rescue services are an important resilience indicator.

The emergency rescue indicators are mapped (locations are approximate) in Figure 5.3. There are just over 1,500 emergency rescue infrastructure locations present in the database. Emergency rescue indicators are not as centralised around populations as are community centres, and this may be by design. The exception to this is special machinery, which tends be located closer to larger populations in the Central Belt and around Aberdeen.

Table 5.2 details the number of emergency resilience indicators across rural and urban areas in Scotland using the Scottish Government's 8-fold rural-urban classification. Only those categories who appear more than one time within a datazone and category are shown. All services can be found in at least one category in the 8-fold rural-urban classification.

Some caution should be taken when looking at the distribution of services across geographical areas. Some services, which might be more centrally located, may also be able to access a relative large portion of the population very quickly. Police and ambulance services can patrol large areas. Helicopters are able to take off and land in a variety of places and can access large geographical areas relatively quickly. In the same vein, coastal safety services are the only emergency rescue service that is found across all rural-urban classifications. This is likely due to the relative small geographies that these types of services cover compared to some other services and the nature of Scotland's coastal areas being spread across the rural-urban continuum.

Table 5.2: Emergency rescue indicators across rural and urban areas

Rescue service category	8-fold rural-urban	Average	Maximum
Ambulance services	Other urban areas	1.04	2
	Very remote rural areas	1.08	2
Coastal safety	Large urban areas	1.45	3
	Other urban areas	1.31	4
	Accessible small towns	1.50	3
	Remote small towns	1.56	3
	Very remote small towns	2.40	4
	Accessible rural areas	1.56	4
	Remote rural areas	1.18	3
	Very remote rural areas	2.04	6
Fire brigade stations	Remote rural areas	1.06	2
	Very remote rural areas	1.16	3
Helipads	Large urban areas	1.20	2
	Very remote rural areas	1.20	2
Special purpose machinery	Large urban areas	2.20	29
	Other urban areas	1.36	6
	Accessible small towns	1.12	2
	Remote small towns	1.20	2
	Accessible rural areas	1.51	18

[a] Average refers to the mean number of indicators per datazone.

[b] Maximum is the highest number of indicators within a rural-urban classification.

5.2.2   Medical services

The emergency medical categories are shown in Table 5.3. Table 5.3 is similar to Table 5.2 in that only those services that appear in more than one category in the 8-fold rural-urban classification are shown.

Overall, the distribution of medical emergency indicators is more spread out across rural and urban geographies. Again, some caution should be observed as the types of resilience indicators included in this category are not as mobile as those found in the emergency rescue services.

Doctor's surgeries are perhaps slightly better spread across the rural-urban geographical continuum. This is due to their high numbers (there are 1,082 found within the database) and their locations across the Central High-

lands and the Islands.

Table 5.3: Emergency medical indicators across rural and urban areas

Rescue Service Category	8-fold rural-urban	Average	Maximum
Chemists and pharmacies	Large urban areas	1.19	4
	Other urban areas	1.32	4
	Accessible small towns	1.22	4
	Remote small towns	1.37	3
	Very remote small towns	2.00	4
	Accessible rural areas	1.01	2
	Remote rural areas	1.03	2
	Very remote rural areas	1.03	2
Clinics and health centres	Large urban areas	1.29	11
	Other urban areas	1.28	6
	Accessible small towns	1.08	2
	Remote small towns	1.08	2
	Very remote small towns	1.33	3
	Accessible rural areas	1.06	2
	Very remote rural areas	1.06	2
Doctors surgeries	Large urban areas	1.51	8
	Other urban areas	1.55	7
	Accessible small towns	1.19	3
	Remote small towns	1.20	3
	Very remote small towns	1.25	3
	Accessible rural areas	1.04	2
	Remote rural areas	1.04	2
	Very remote rural areas	1.16	3
Mental health centres	Large urban areas	1.30	7
	Other urban areas	1.15	3
	Accessible rural areas	1.18	4

[a] Average refers to the mean number of indicators per datazone.
[b] Maximum is the highest number of indicators within a rural-urban classification.

5.2.3   Resilience through social capital

An important caveat of this research is that it largely focuses built capital (i.e., structures that represent strong areas resilience). According to
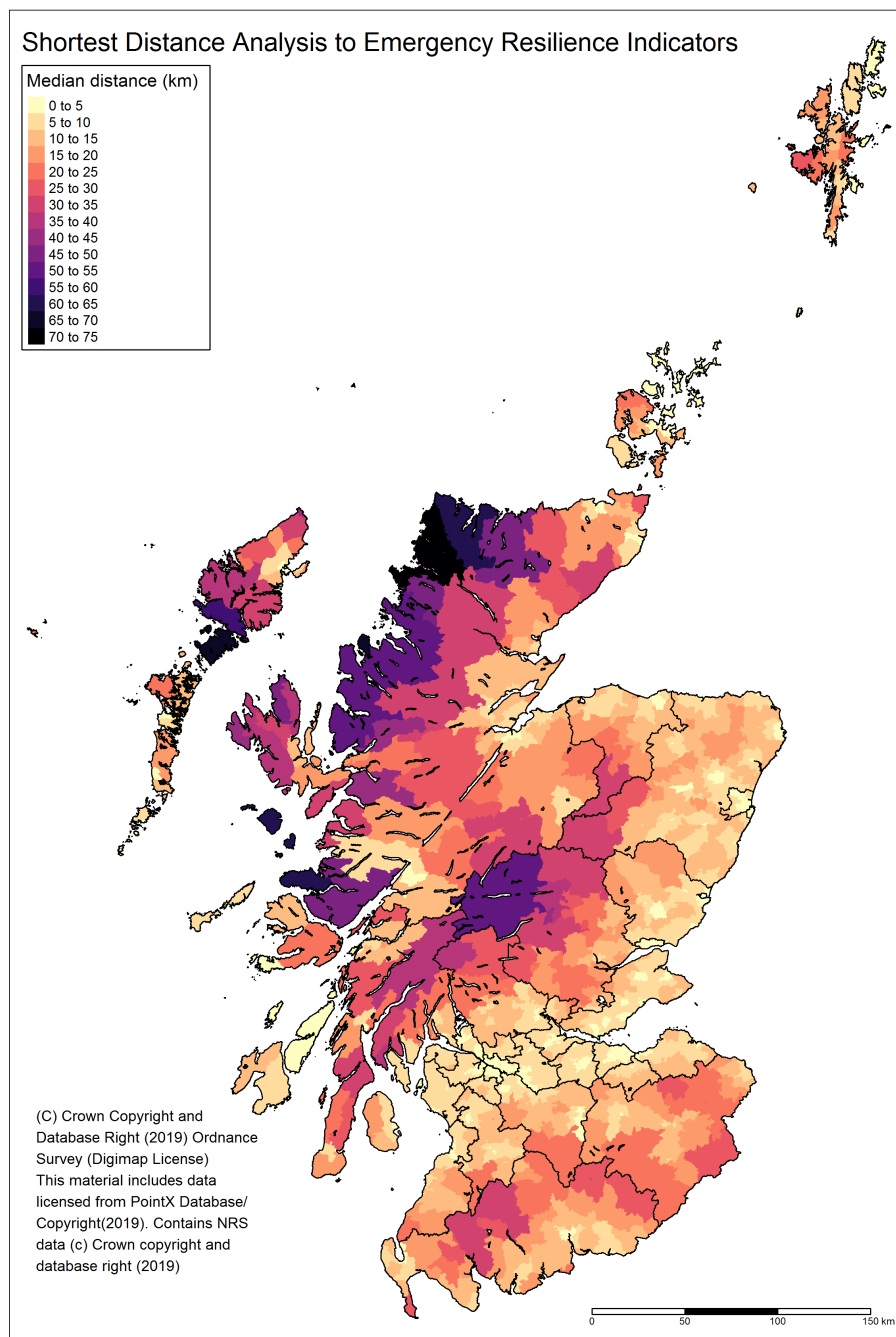
Figure 5.3: Approximate locations of places within the emergency rescue resilience category in the resilience indicators database
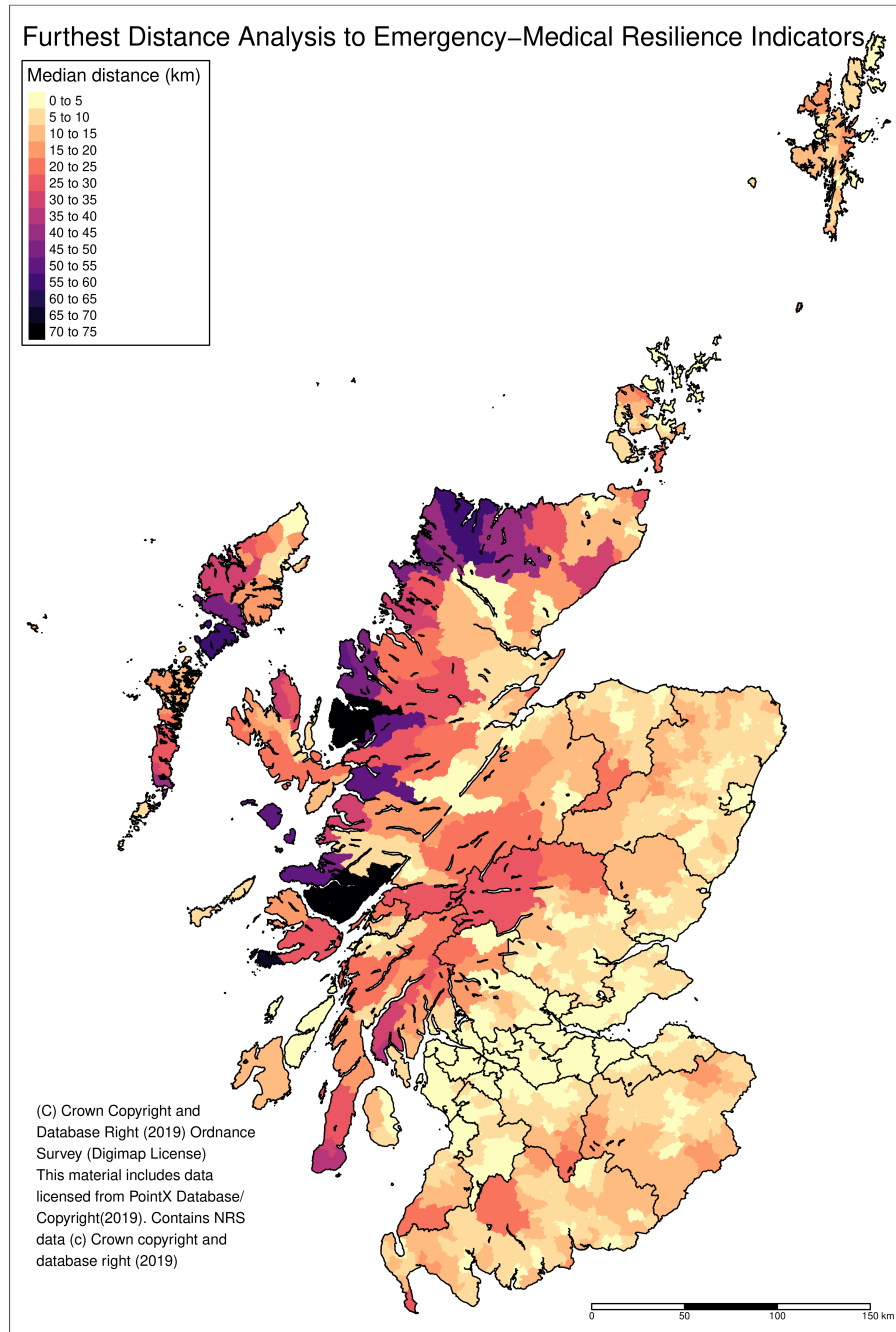
Furthest Distance Analysis to Emergency–Medical Resilience Indicators

Median distance (km)
- 0 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25
- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 45
- 45 to 50
- 50 to 55
- 55 to 60
- 60 to 65
- 65 to 70
- 70 to 75

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Figure 5.4: Approximate locations of places within the emergency medical resilience category in the resilience indicators database

the stakeholder interviews, resilience is something much deeper than built capital – it also has to do with the relationships of people living in the area. In order to include some indication of local relationships and regional situations, we have included data that measures trust in one's neighbourhood and vehicle ownership. Trust in one's neighbour is a measure of social capital (see Section 1.2.1). Including access to vehicle ownership allows for the proportion of those with easy access to the road network to be included in the analysis. These data come from the Scottish Household Survey 2016 and Scottish Census 2011. They are both quite a bit older than the resilience indicators, and the Scottish Household Survey is aggregated to the local authority level (not the datazone level). We have classified findings from the Scottish Household Survey using the RESAS definition of rural, which classifies local authorities into four categories[1].

Neighbourhood trust

There are four questions in the Scottish Household Survey that have particular relevance to resilience as its conceptualised in this study.

1. Would you offer help to your neighbours in an emergency?

2. Can you rely on your neighbours to help in an emergency?

3. Do you think your neighbourhood has gotten better, stayed the same or gotten worse?

4. How would you rate your neighbourhood as a place to live?

Together, these questions do a good job of measuring how people in a certain area feel about coming together in a time of need. The results for analysing these questions is shown in Figure 5.5 to Figure 5.8. Overall, people living in rural areas in Scotland report being more likely to receive and provide help to their neighbours in an emergency. They are also more likely to report that their neighbourhoods are good places to live – this is a general indicator of stronger social capital.

These results will be factored in to the Resilience Indicator database.

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[1]For more information visit https://blogs.gov.scot/rural-environment/2018/02/23/understanding-our-rural-economy/resas-classification/
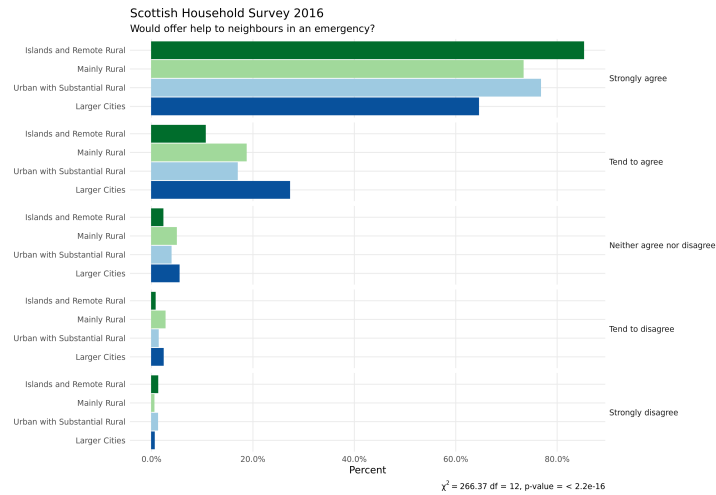
Figure 5.5: Rural places are more likely to help their neighbours in an emergency
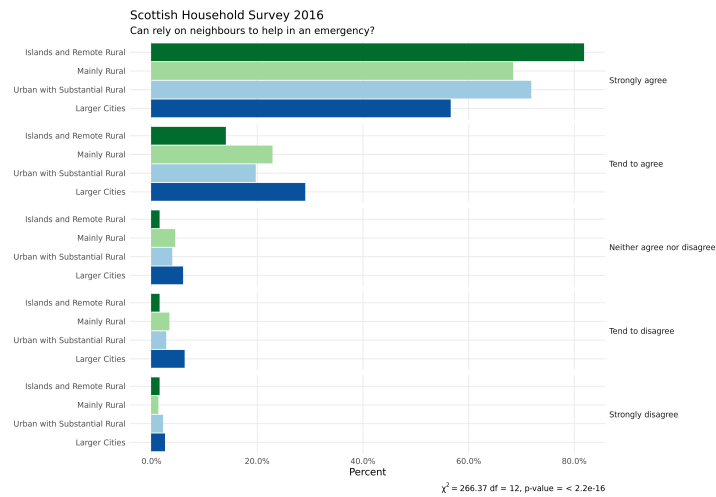

Figure 5.6: Rural places are more likely to think they can rely on their neighbours in an emergency
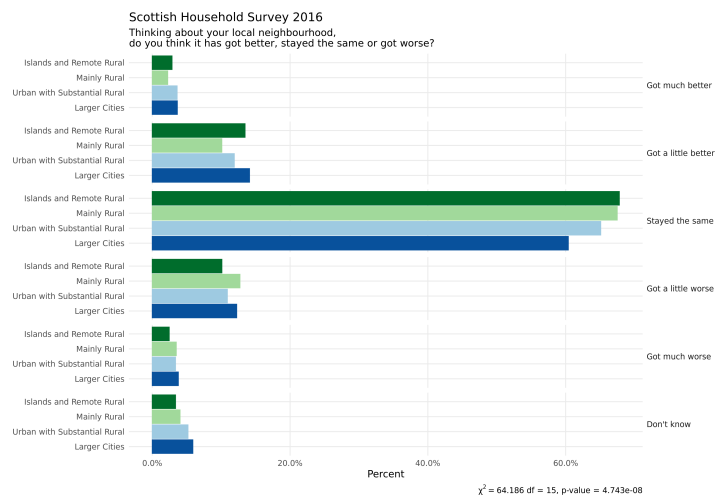
Figure 5.7: Rural places are slightly more likely to think their neighbourhood has gotten better
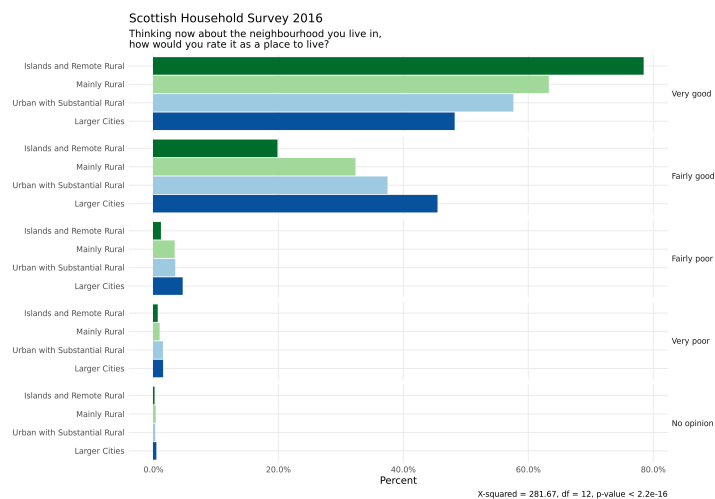

Figure 5.8: Rural places are more likely to rate their neighbourhoods as good places to live

Accessing services

The Resilience Indicators database is created using the Scottish road network. It assumes that people can access the infrastructure in a car or truck. It is worth capturing car and truck ownership as these rates differ between rural and urban areas.

Figure 5.9 shows the relationship between the proportion of people with limited health and no access to car and their median distance to a medical-emergency resilience indicators. The Scottish Government rural-urban classification is included as well. The results shown in Figures 5.5 to 5.8 are statistically significant at the $p < 0.001$ alpha level. This suggest that the these results are representative of the true distributions, which is worth noting as the SHS is a survey of about 10,000 respondents (not a census).

It is not surprising that people in more rural areas have longer to travel to reach a medical-emergency indicator[2]. There is, however, a higher proportion of people living in rural and remote areas that have ill health and no car. These people may struggle to reach a medical-emergency indicator – especially in time of emergencies.

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[2]The Scottish Government classification is developed, in part, by looking at distance-to-service for an area.
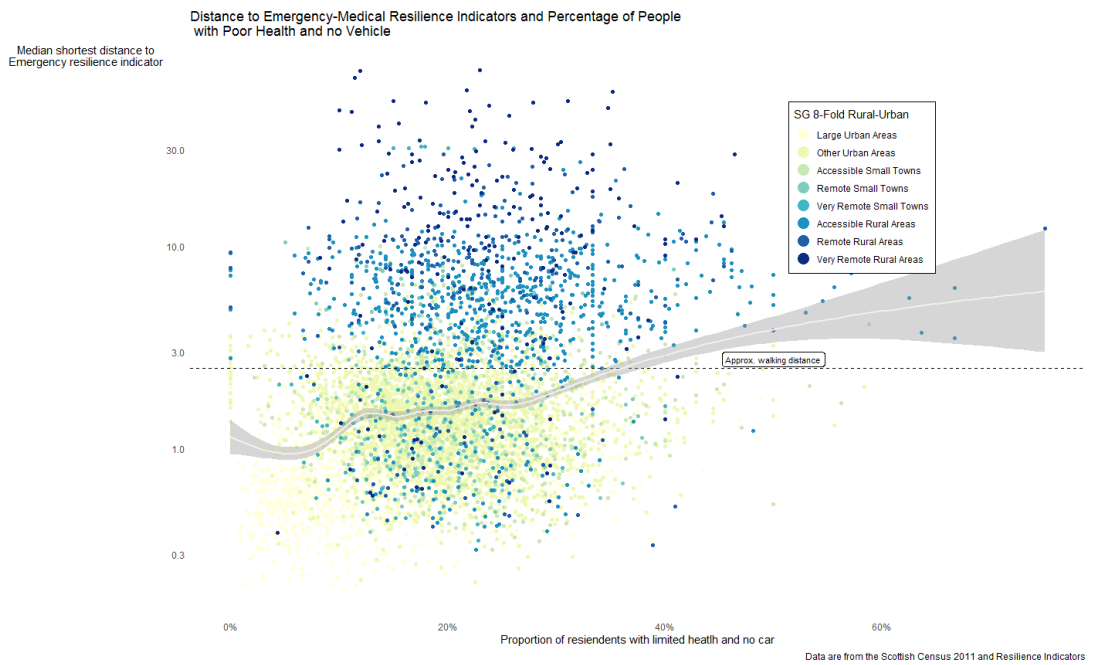
Figure 5.9: The proportion of people with bad health and no car is slightly higher in rural areas

Chapter 6

Hot Spots of Resilience

This chapter introduces case studies of *hot spots* of resilience in rural places in Scotland. Case study areas are at the local authority area. Hot spots of community resilience are places that have high numbers of resilience indicators. Because we are interested in rural areas in Scotland, and different local authorities have more land designated as rural or remote than others, it is necessary to control for the total rural and remote areas.

6.1 Resilience metric

A straight-forward way to do this is to create a metric that can be applied to different resilience indicator categories and across different rural and urban geographies. The resilience metric is calculated using the following approach.

1. Find the total number of each resilience indicator in all resilience categories for each level of the Scottish Government's 8-fold rural-urban classification by local authority

2. Find the total number of datazones for each level of the Scottish Government's 8-fold rural-urban classification by local authority

3. Find the ratio of these two numbers

Datazones are good base geographies for the resilience metric as they are designed to have between 500 and 1,000 people. Datazones are included in the resilience indicators database.

It should be noted that this particular metric calculation can be beneficial when looking at resilience **within specific rural and urban areas**. It attempts to compare like with like. It is not intended as a general metric of community resilience, and as will be demonstrated, it is not suited to compare resilience across the rural-urban continuum.

6.1.1 A resilience metric in everyday resilience indicators

The resilience metric is shown for community centres and halls, doctors surgeries and police stations in Figures 6.1 through 6.3. The metric tends to be a better indicator of hot spots of resilience for those local authorities with high numbers of rural datazones. Like many statistical tests, it becomes more error prone as the sample size becomes too low.

Looking at Figure 6.1, we can see that Argyll and Bute has a resilience metric score within the community centres and halls category of about 1.5 with 66 community centres and halls. This suggest that within the most rural and remote places in Argyll and Bute, there is about one community centre per 500 people. [1] Whereas Highland council has about one community centre per 625 people in the most rural and remote areas.[2]

Community centres are a strong indicator of everyday resilience. According the resilience metric results shown in Figure 6.1, Argyll and Bute, Na h-Eileanan an Iar (*Western Ilses*), Orkney Islands and Highland council all fair pretty well. Each local authority has a resilience metric of over 1.20 and each has an $n \geq 20$.

In contrast, when we consider the same metric in large urban areas we see much lower scores. Table 6.1 shows similar results to those shown in Figure 6.1. East Lothian is the highest scoring local authority with a resilience metric of 0.38. We see consistently lower scores in large urban areas when compared to very rural and remote areas.

However, we are comparing apples to oranges. The expansive geographies of rural and remote datazones when compared to large urban areas prevents their direct comparison using the resilience metric. Datazones in urban areas, where populations are dense, tend to have much smaller areas. This makes accessing services outside of one's datazone easier. In

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[1] If we assume that each datazone has about 750 people we get $\frac{750}{1.5} = 500$.

[2] Again, assuming each datazone has about 750 people, $\frac{750}{1.2} = 625$.
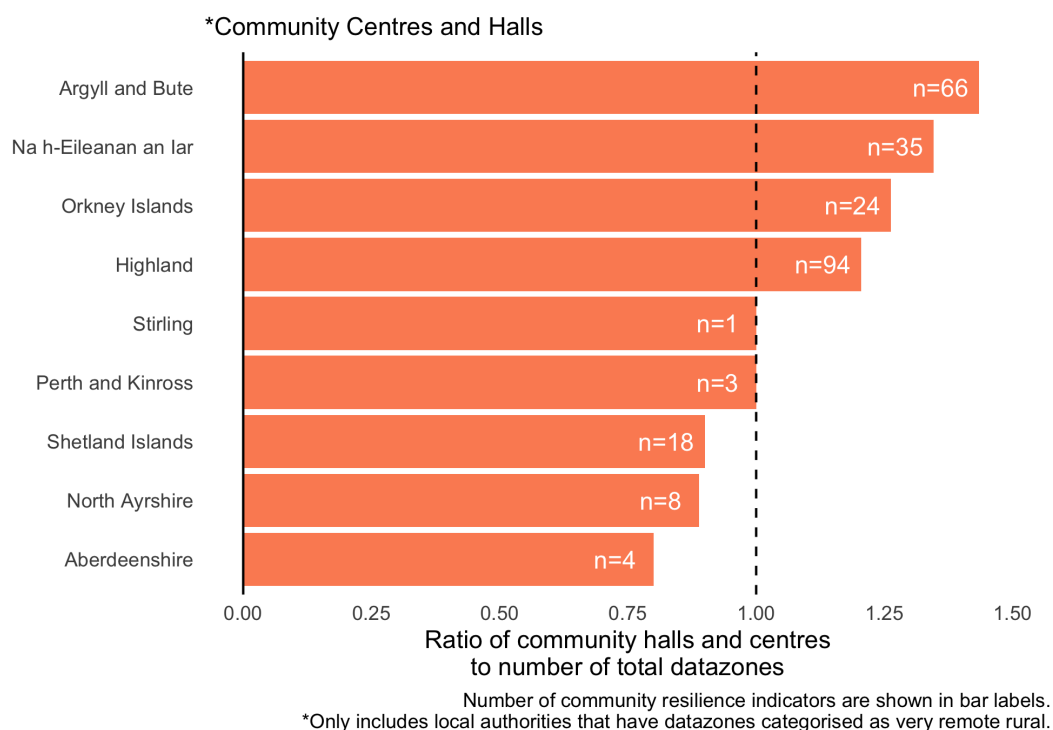
Figure 6.1: Ratio of community indicators to datazones in very remote rural places

rural and remote datazones one can travel miles to reach services and still be in the same datazone.

Table 6.1: Resilience metric in large urban areas

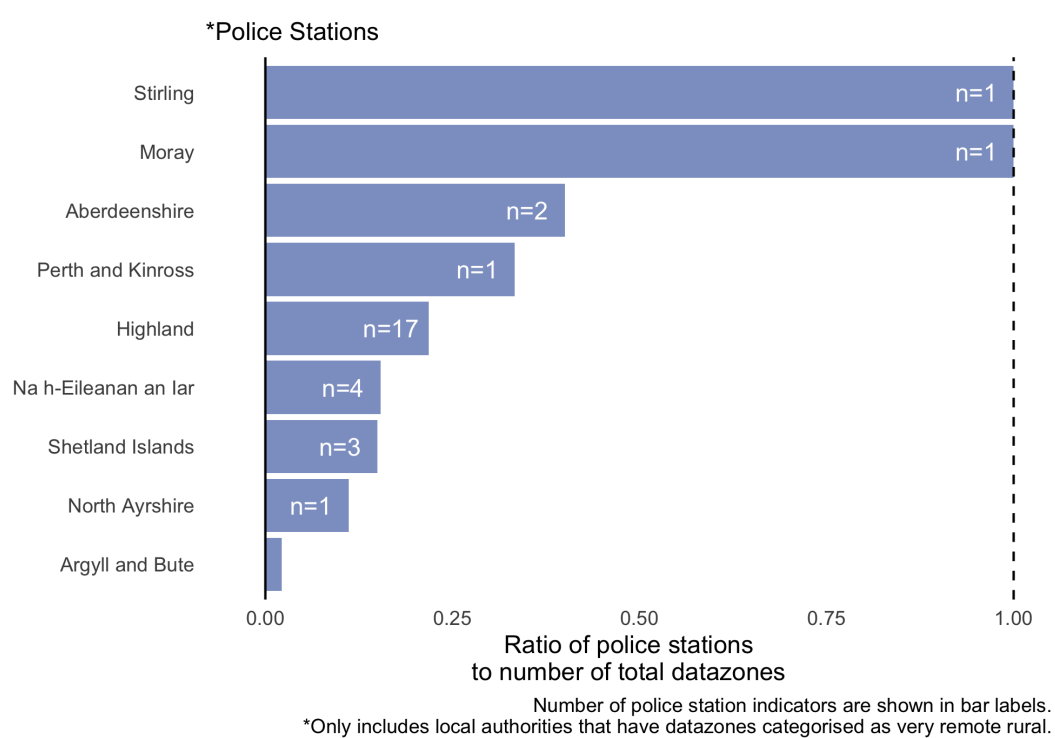| Local authority	Community centres	Datazones	Resilience metric
East Lothian	12	32	0.38
Aberdeen City	79	266	0.30
West Dunbartonshire	14	57	0.25
South Lanarkshire	19	80	0.24
City of Edinburgh	104	576	0.18
Renfrewshire	29	169	0.17
East Renfrewshire	18	107	0.17
Glasgow City	126	743	0.17
East Dunbartonshire	12	80	0.15
Dundee City	23	187	0.12

*Police Stations

Figure 6.2: Ratio of police indicators to datazones in very remote rural places
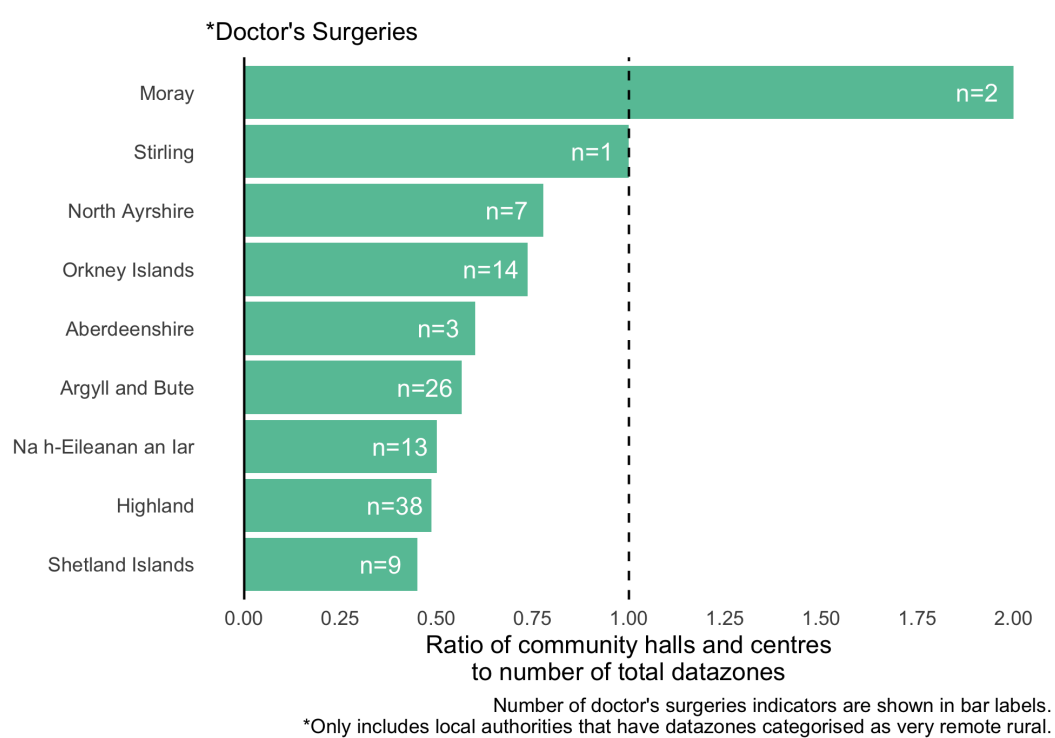
Figure 6.3: Ratio of doctor's surgeries indicators to datazones in very remote rural places

6.2   Hot Spots of Resilience

We now consider two case studies areas to examine how community resilience indicators differ within local authorities in Scotland. Going back to the project research question, we will now look at the ..."extent [that] emergency and everyday resilience centres exist across rural Scotland?" Based on the metric results shown in Figure 6.1, Argyll and Bute and Highland council will now be reviewed in terms of hot spots and not spots of resilience within each local authority area.

6.2.1   Argyll and Bute

Argyll and Bute is a coastal local authority area located on the west coast of Scotland. Approximately 85,000 people live in Argyll and Bute, with significant proportions of the population living on islands. Argyll and Bute has a portion of the Loch Lomond and the Trossachs National Park, home to hills and mountains.

The everyday and emergency resilience indicators in Argyll and Bute are mapped in Figure 6.4. There are 95 community centres and halls in Argyll and Bute, and a large percentage of these are located in very rural and remote areas.

Argyll and Bute also has a large number of pubs and inns, at 82. Both community centres and local pubs and inns are important structures to ensure an area is resilient to both the everyday and emergency threats. Argyll and Bute's location on the west coast means that it is susceptible to large storms that come ashore from the Atlantic ocean. There are 42 coastal rescue stations dotting Argyll and Bute's coast, which is by far the highest in emergency rescue category.

There is a good spread of resilience indicators across both rural and urban areas. All datazones have at least one resilience indicator within their borders. This helps to make Argyll and Bute a hot spot of resilience in Scotland.

6.2.2   Highland

We now consider resilience indicators in Highland council local authority area. Highland council is the largest authority area geographically in
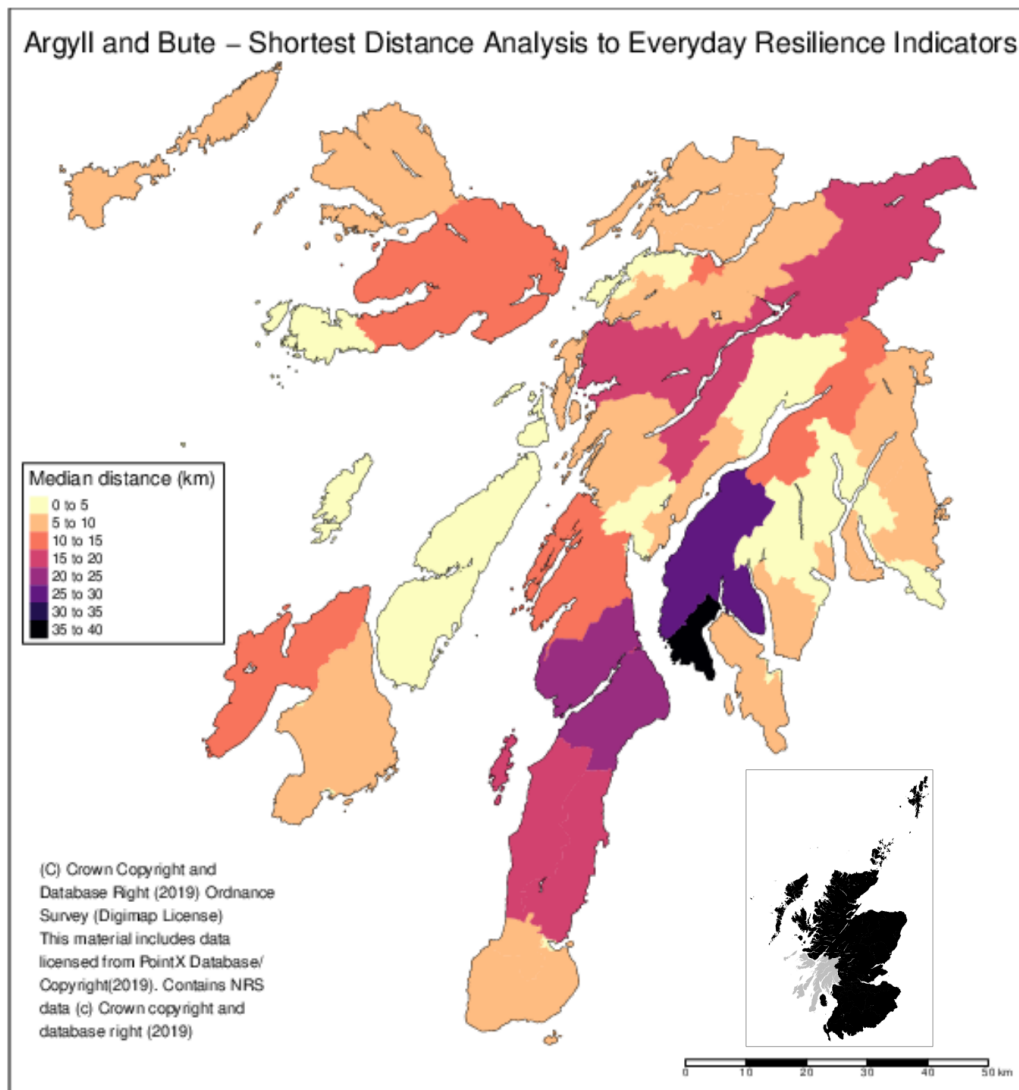
Figure 6.4: Argyll & Bute, hot spots of resilience map

Scotland, and it comprises land from central Scotland and up the North-western coast. Over 200,000 people live in Highland council, and it has some large cities like Inverness that act as hubs for the surrounding areas. The north and west coasts of Highland council are home to transportation hubs connecting via ferry to the Western Isles and Orkney Islands.

Figure 6.5 illustrates the everyday and emergency resilience indicators in Highland council. Highland council's largest category of everyday resilience indicators is sports hall, with about 220 total complexes. It also has about 200 community centres.

A high majority of resilience indicators in Highland council are located on the geographical periphery. There are large portions of the interior that have small numbers of resilience indicators. Resilience indicators also appear to be at the geographical periphery of datazones in Highland council. Some caution should be exercised when considering the locations of resilience indicators in Highland council. What is not shown is the population densities within datazones. Whilst datazones are meant to contain similar population sizes, it is plausible and perhaps likely that most people live on the periphery. Furthermore, Highland council's proximity to the Western Isles and the Orkney Islands likely plays a role in the location of its resilience indicators. If it does indeed support the everyday and emergency resilience of the islands off its coast, then the concentration of resilience indicators at these locations is a logical choice.

Still, Highland council is well represented by a myriad of resilience indicators, and it is for this reason that it is a hot spot of resilience in Scotland.
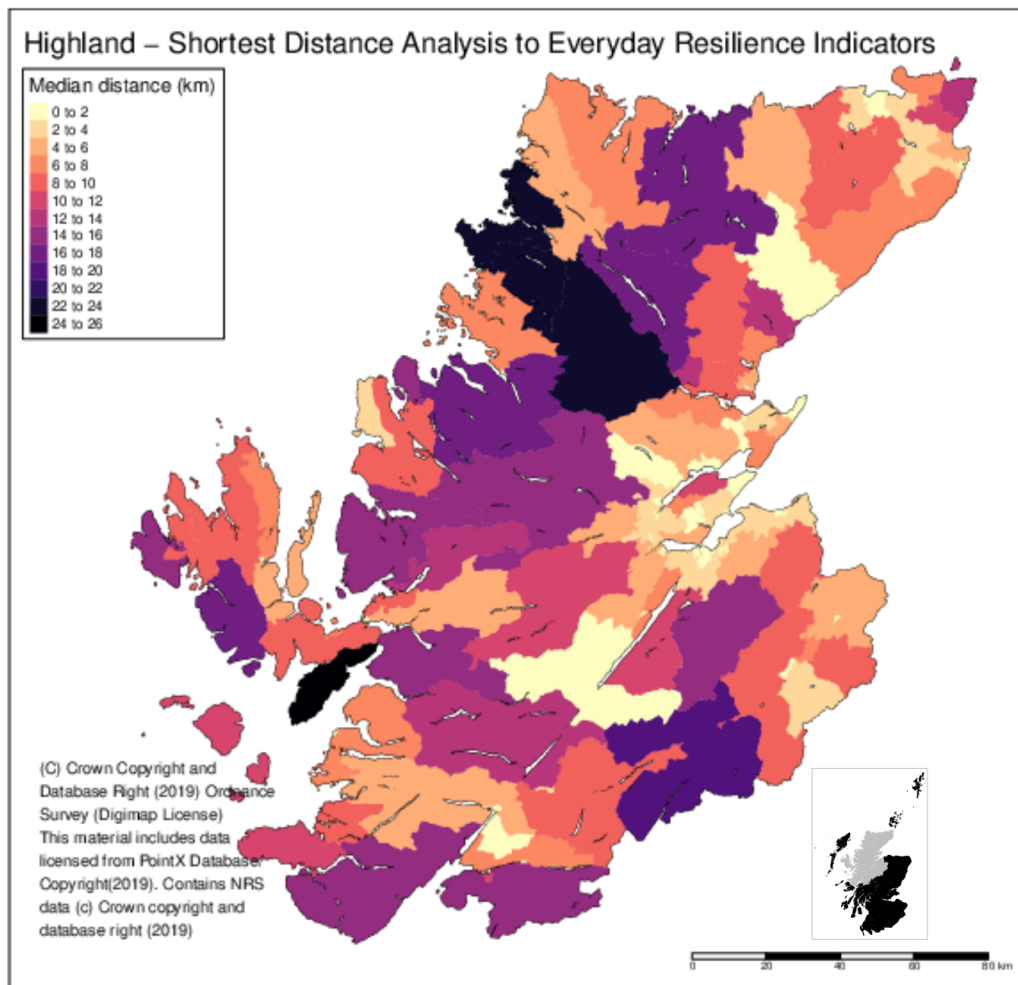
Figure 6.5: Highland, hot spots of resilience map

Chapter 7

Discussion

Resilience is in many ways concerned with the ability of relationships within a system to absorb change. These relationships span across institutions and people. The policies in Scotland aimed at improving community resilience recognise the importance of institutional and social relationships. Ready Scotland calls this approach *joined-up*, and they propose that resilient partnerships co-ordinate with one another to achieve resilience.

Results suggest that there are different types of structures in Scotland that promote both emergency and everyday resilience. Furthermore, there is often a great deal of overlap in the types of resilience structures, with many places serving joint functions in resilience preparedness. Community centres or village halls were found to be quite prevalent across rural Scotland. These types of organisations can be used to help coordinate response teams in times of crisis, and they can support civic activity and the creation of local relationships that help mitigate the everyday threats to resilience.

7.1   Recommendations

The findings from this project can be found in the Resilience Indicators database that accompanies this report as a project output. The Resilience Indicators database will have the capacity to be used with mapping software (e.g. ArcGIS and QGIS). It can also be used as a stand alone database that can be linked with Scottish or UK databases. The Resilience Indicators database is not meant to take the place of local knowledge or intended to

be used as a single approach to resilience planning. Rather, the Resilience Indicators database can serve as an aid for local experts to help them identify structures that can help promote local resilience. The following recommendations are ways that the Resilience Indicators database may be useful:

1. By local resilience groups and organisations – Resilience groups from around Scotland can use the database to help identify locations in their areas that might be useful in times of emergencies. Organisations like Ready Scotland may benefit from using the Resilience Indicators database help in identifying areas in Scotland that be be more or less prepared for certain hazards.

2. By civic organisations – The Resilience Indicators database has indicators that are beneficial to protecting against the everyday resilience, and many of these structures serve to increase local relationships and civic engagement. Civic organisations may use the Resilience Indicators database to help organise volunteer groups or hold community meetings on local issues.

3. By others who research resilience – the Indicators Database can be easily merged with other research on resilience in Scotland. For instance, climate modellers can use the database to model the future of community resilience in Scotland based on likely changes in climate predictions.

7.2   Project Limitations

Whilst outputs from the project are hopeful quite useful to stakeholders, there are some key limitations with the study that impact how the results should be interpreted and how the Resilience Indicators database should be used.

First, this a high-level attempt to map indicators of resilience in Scotland. The study used a ground-truthing approach to qualitatively identify the types of structures that may be useful to mitigate threats to the everyday and emergency resilience. However, indicators included in the database will likely not be used in the same way across different communities in Scotland. For these reasons, it is not useful of beneficial to use the Resilience Indicators database to rank areas in terms of their more or less resilience. Doing so is effectively comparing apples to oranges.

Second, many indicators included in the Resilience Indicators database may require an expert understanding their exact impact on resilience. Users should therefore exercise caution when using the Resilience Indicators database specifically when:

1. Engaging in tasks that include identifying local area resilience capacity, especially in emergency situations. *Experts in fire/police and off-shore rescue should be included in these tasks to ensure accuracy in interpreting results.*

2. Identifying resilience around health care services and provisions. *Medical and health care professionals should be included in these tasks to ensure accuracy in interpreting results.*

3. Measuring an area's capacity mitigating against threats to everyday resilience. *Local experts should be included in these tasks to ensure accuracy in interpreting results.*

The Resilience Indicators database should be used as a tool by experts in resilience to aid in their current knowledge and expertise.

7.2.1   Future Work

The Resilience Indicators database is hosted on *Zenodo.com*[1]. It is freely available to use in research dealing with resilience (or any related area). The database is aggregated at a low-level geography, and it can easily be linked with other database and models. Future work using the Resilience Indicators database can take advantage of the database's geopackage format – maps and GIS analysis can easily be carried out with the database. An interesting area of study is around climate projections. The Resilience Indicators database could be including in climate projection models to look at the future of resilience infrastructure in different climate scenarios.

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[1]You can download the database here https://zenodo.org/record/3386198.XYUE2ZNKh24.

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