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Demographic Projections for the Scottish Sparsely Populated Area (SPA) 2011-2046

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Acknowledgements

I would like to acknowledge the help of my colleague Jonathan Hopkins, who provided the baseline Population Census data, the starting point for the projections.

The spreadsheet projection model which is central to the work reported in this paper was originally developed in the context of the Northern Periphery and Arctic Programme project REGINA, during my secondment to Nordregio (Stockholm).

Any views expressed in this working paper are those of the author and do not represent those of the funder (the Scottish Government).

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1. Introduction

This working paper is the third output of a project funded by the Scottish Government's Rural and Environment Science and Analytical Services (RESAS) division's 2016-2020 Strategic Research Programme[1]. More precisely this work has been carried out under Research Deliverable 3.4.1. The research question addressed by this project is "How do changes in the population of remote rural areas of Scotland affect the social, economic and ecological resilience of these areas?". It thus explores the land use, economic and environmental implications of demographic change in the sparsely populated areas (SPA) of Scotland.

The story so far…

The first step in such an exercise is to define more precisely the territory which is commonly referred to as "remote" or "sparsely populated". This question was addressed by our first working paper (Copus and Hopkins, 2017), which is available on the project's website[2]. It describes how we identified the SPA of Scotland, using Geographic Information System (GIS) analysis which took account not only of sparsity but also the size of the population which is accessible within thirty minutes travel time. Following this, the SPA has been divided into six "sub-regions" (Map 1), as a framework to allow investigation of local differences in demographic trends, economic activity, and potential consequences for provision of ecosystem services.

Our second working paper (Hopkins and Copus, 2018) provides a summary of what is known about demographic change (1991-2037) in the SPA, from the Population Census, the annual Special Area Population Estimates (SAPE) and Sub-Council Area Projections (SCAP). Of these three sources only the first allows fine grained analysis of data for the Sparsely Populated Area defined (as a combination of Output Areas) in our first working paper. Both the SAPE and SCAP datasets relate to larger "building blocks" (data zones and custom-defined areas), and as a result the detailed narrative of demographic change and our understanding of likely future developments from these sources is indicative, rather than authoritative. In other words, some of the SAPE and SCAP population featured in the analysis of our second working paper are inevitably mis-classified as SPA or non-SPA. In response to this we have carried out our own population projections for the SPA and its sub-regions (tightly defined), and these are the subject of this third working paper.

The structure of this working paper

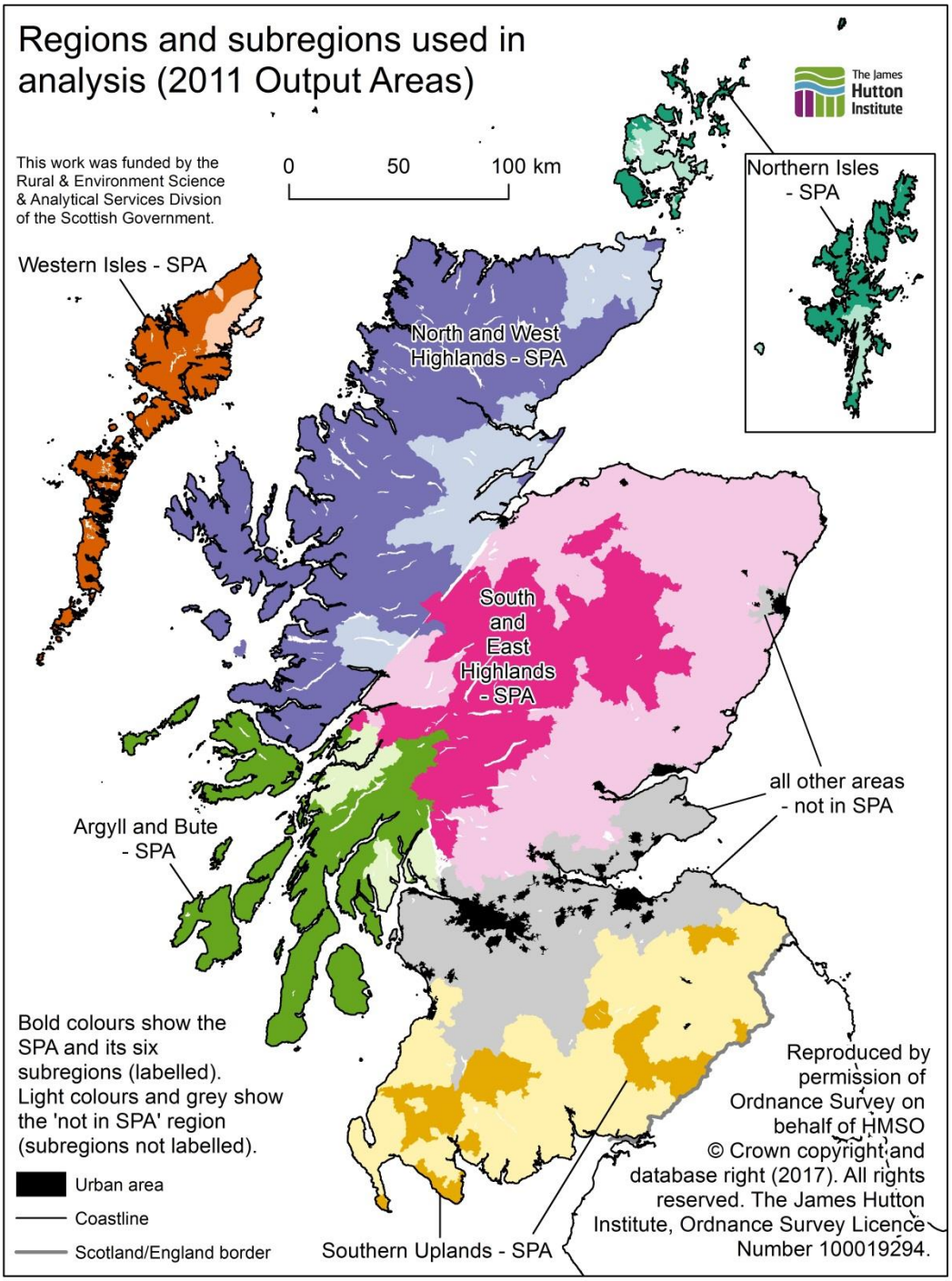
A short account of what is available, in terms of regional demographic projections, in other countries of NW Europe with sparsely populated areas is helpful background, because it highlights some of the challenges, and the various ways in which they are overcome. This is followed by a description of the various projections developed for Scotland by National Records of Scotland (NRS). This is followed by the presentation of a simplified projection model, designed to meet the challenges of relatively small populations, which has been successfully applied in the context of four municipalities participating in a recent Northern Periphery and Arctic Programme project. The application of this model to the SPA and its sub-regions, and the resulting projections are described, followed by a consideration of what

[1] http://www.gov.scot/Topics/Research/About/EBAR/StrategicResearch/strategicresearch2016-21/srp2016-21 [accessed 31st January 2017]

[2] http://www.hutton.ac.uk/research/projects/demographic-change-remote-areas

the findings add to the demographic narrative presented in our second working paper. Brief reflections on potential policy implications conclude this working paper.

Map 1: The Sparsely Populated Area (SPA) of Scotland and its sub-regions



The calculation of the SPA is described in Working Paper 1, available for download at the project webpage: http://www.hutton.ac.uk/research/projects/demographic-change-remote-areas.
SPA/not in SPA areas and subregions, and urban areas derived from 2011 Output Area Boundaries: Clipped to the coastline (MHW) © Crown copyright. Data supplied by National Records of Scotland. Areas classified by Scottish Government Urban Rural Classification 2013-2014, based on information in Lookup Files (http://www.gov.scot/Resource/0046/00464793.zip) © Crown copyright. Contains public sector information licensed under the Open Government Licence v3.0. Scotland/England border from Ordnance Survey Strategi® data, coastline from Ordnance Survey Boundary-Line™ data. Colour scheme adapted from information at http://colorbrewer2.org/ © Cynthia Brewer, Mark Harrower and The Pennsylvania State University.

2. Why not use available population projections?

Regional and local population projections in the Nordic countries…

Producing population projections for countries or regions has long been an activity of national statistical agencies, and National Records of Scotland is no exception. Although there are variations in the detail, from country to country, the same basic model is almost universally employed. This involves dividing the population into one year-male/female age groups (cohorts), and applying annual fertility/mortality and migration rates stepwise, one year forward at a time. This single year cohort method works well for larger regions, where the numbers in any cohort are sufficiently large not to be distorted by random effects. However, applying this method to a small and sparsely populated area, which has a population of only a few thousand people is much more vulnerable to the "small number problem". In addition, in countries (such as the UK) which do not have a statutory residence register, intra-regional migration is rather poorly documented. Between Censuses, which take place every ten years, migration within the national borders is estimated from indirect administrative sources. For these reasons while most Western European countries have well established arrangements for projecting future population at the national level, there is greater variation between them in respect to regional or local projections, as the following examples from the Nordic countries illustrate.

In Finland projections are estimated at the municipality level through to 2065[3]. Fertility and mortality rates are not estimated for each municipality (because the populations are generally too small as the basis for reliable age/gender specific rates), but for groups of municipalities. These groups of municipalities are not contiguous regions, but are defined by their common demographic trends. The national projection is basically the sum of the municipality projections. In Norway, the methodology is similar, except that calculations are carried out with data for 108 "projection regions" and then apportioned to constituent municipalities (Norgård Aase et al., 2014)

In Sweden, official population projections are carried out at the national level. The approach is an unusual one, structured by "clusters" of housing types, rather than regions or municipalities. The reasoning is that numbers of inhabitants are rather small in many remote and rural areas, and statistically reliable estimates of the components of change are better made on the basis of grouping people (nationally) according to what kind of property they live in. The only way in which geographical differences can come through is on the basis of a 3-fold size of city classification (Franzen and Karlson, 2010).

…and in Scotland

In Scotland, projections of the Scottish total population are carried out in a way which is consistent with those for the other countries in the UK (NRS, 2014, 2016). All sub-national projections, including those for Council Areas, Health Board areas, Strategic Development Plan Areas (SDPA), and National Parks (NP) are adjusted to make them consistent with the Scottish total. All these geographies are built up from a set of 42 "processing units", which are either council areas or parts of council areas. Eight Council Areas are split into two parts, and one into three parts, by the intersection of SDPA or NP boundaries. Initial projection calculations are carried out at the processing unit level. These

[3] https://www.stat.fi/til/vaenn/2015/vaenn_2015_2015-10-30_laa_001_en.html [accessed 23rd January 2018]

projections are subsequently adjusted so that they sum to the national projections. The administrative areas listed above are the only ones for which regular projections are available. However, experimental projections have recently been produced for 301 "Sub-Council Areas" (SCAP). These too are constrained so that they sum to the Council Areas and to the national projections. The SCAP projections formed the basis of our first look at future population trends in the SPA, the analysis being reported in Hopkins and Copus (2018). In the account of the projections carried out by this project which follows, the new projections will be referred to as SPA projections, to distinguish them from the SCAP projections described in our second working paper.

3. The Projection Model

Quinquennial cohorts as a solution to the small number problem

In all the above cases projecting the population involves dividing it into one-year male/female age groups (cohorts), and applying annual fertility/mortality and migration rates stepwise, one year forward at a time. This single year cohort method works well for larger regions, where the numbers in any cohort are sufficiently large not to be distorted by random effects. However, applying this method to a sparsely populated area which has a population of only a few thousand people is much more vulnerable to the "small number problem" (hence the use of housing clusters in Sweden, groups of municipalities in Finland, and projection regions in Norway).

In the projection model which we have used to produce the forecasts of population change for the SPA (described below), the small number problem is ameliorated by using a five-year (quinquennial) cohort model, and projecting forward five years at a time. Not only does this reduce the impact of random variation in the baseline age structure data, it makes for smaller, more manageable tables, without (arguably) a meaningful sacrifice in terms of accuracy.

The projection process

The projection model was developed in the context of a recent European Union funded project (REGINA[4]) which sought to provide planning tools to support small municipalities in the Northern Periphery and Arctic regions, which are facing issues very similar to those of the Scottish SPA. It is implemented in an Excel spreadsheet, and is designed to be readily accessible to non-specialist users.

Its data requirements are as follows:

1. Base year (male and female) populations for five-year cohorts, from 0-4 up to 85-89, and then for all persons aged 90 and over.
2. Average annual fertility rates (per 1,000) for each female cohort from 15-19 up to 45-49.
3. Average annual mortality rates (per 1,000) for all cohorts, male and female.
4. Average annual migration rates – for each cohort, distinguishing males and females, and in-migration from out-migration.

Details of the input data used in the SPA projections are provided in Annex 1.

[4] http://www.reginaproject.eu/

It is worth pointing out that the key drivers which determine the outcome of the projection model are the age structure of the initial population, and local migration characteristics. Fertility and mortality rates typically do not vary very much across countries of the developed world.

The model also requires estimates of how fertility and mortality rates are likely to change in each successive projection period. These have to be based upon assumptions and expert judgements. The best source for these is the documentation of NRS projections at the national and regional level. Future migration trends have been assumed to be a continuation of those of the past decade.

The model uses a relatively straightforward iterative sequence of simple calculations. After the baseline data and the fertility, mortality and migration rates are entered, these are used as the basis for the projected population for the next five-year period. The sequence of calculations is as follows:

1. The initial estimate of the 0-4 population for the first projection period (five years after the baseline, i.e. t+5) is estimated by multiplying the number of females in the 15-49 age cohorts by the appropriate fertility rates.
2. Each of the other baseline cohorts is moved "down" one row, to represent them ageing 5 years. The 90+ age group in t+5 must be estimated in a slightly different way. First, the baseline 85-89 population is moved into the 90+ cohort for t+5. To this is added the number of persons who were 90+ in the baseline year, and are expected to survive until 95 or over in t+5.
3. All the new (t+5) cohorts (including 0-4) are adjusted for mortality, by applying the appropriate age/sex specific mortality rates.
4. Estimates of in-migrants and out-migrants are added and subtracted from each age group.
5. The same sequence is followed to generated the population distribution for the third time-period, and so on.

The results of the projection are immediately displayed in a "dashboard" layout, consisting of graphs and tables. Dashboards for each of the sub-regions are reproduced in Annex 2. This is an important feature of the model in that it encourages experimentation with the inputs, by providing immediate feedback on the effects in terms of future population size and structure. This capability will be exploited later in our project to assess the implications of a variety of migration scenarios. In this working paper we will present initial projections, based on the conventional assumption that future trends (in fertility, mortality, and especially migration) will be a continuation of those of the recent past. One particularly interesting element of the dashboard is a graph showing the scale of net migration required to prevent further "shrinkage" of the population.

Specifying the projections; sources and assumptions

The starting point for the SPA projections was 2011 Census data[5], aggregated from individual output areas to the six SPA sub-regions, for 5 year age cohorts (split by gender), from 0-5 to >90 years[6]. Persons living in communal establishments (prison, armed forces, student halls etc) are excluded from the analysis. Fertility and mortality rates for each projection period were derived from the National Records of Scotland (NRS) *2012 based projections for Scottish Areas* [7]. Our SPA sub-region

[5] Data: © Crown copyright. Data supplied by National Records of Scotland.

[6] The quinquennial cohort structure means that children have to be defined as 0-15, rather than the conventional 0-16.

[7] https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-projections/sub-national-population-projections/2012-based/list-of-tables

projections are therefore consistent, in terms of the underlying assumptions about natural increase, with the NRS projections for "sub-national areas"[8].

The NRS 2012-based projections web page includes data tables showing fertility assumptions for each year through to 2037, in the form of national rates, together with "scaling factors" for each of the Scottish Council Areas. For each SPA sub-region (and each 5-year age group) average fertility rates for 2011-15 were estimated as weighted averages of the rates for constituent Council Areas. The percentage changes in fertility rate for each five-year period through to 2031-35 were estimated at the national level, and applied to all sub-regions. For the 2036-2046 periods the 2031-35 rates of change were assumed to continue. A similar approach was used for mortality rates.

The source for migration rates (in and out and by gender) was the NRS spreadsheet "Migration to and from Administrative areas by Age"[9], and more particularly the tables showing in and out migration by 5 year age cohort and gender, expressed as a percentage of annual population estimates. The rate of change in migration was estimated on the basis of average rates during the period 2001-15[10].

4. Projection results (2011-2046) for the SPA and its Sub-regions

In this section we report the findings of the implementation of the simplified projection model to 2011 Census data for the output areas which compose the SPA sub-regions. These differ from the SCAP area projections which were discussed in our second working paper (Hopkins and Copus, 2018), in that there is an "exact fit" rather than a best fit approximation to the boundaries of the SPA and its sub-regions.

The SPA population is forecast to decline – in all sub-regions

Table 1 shows that according to the above assumptions the SPA as a whole is projected to lose approximately 28% of its population by 2046. Losses of 30% or more are projected in the Western Isles, Argyll and Bute and Southern Uplands. At the other extreme the Northern Isles have projected losses of 19%, whilst the SE Highlands seem set to lose 25%, and the NW Highlands 28%.

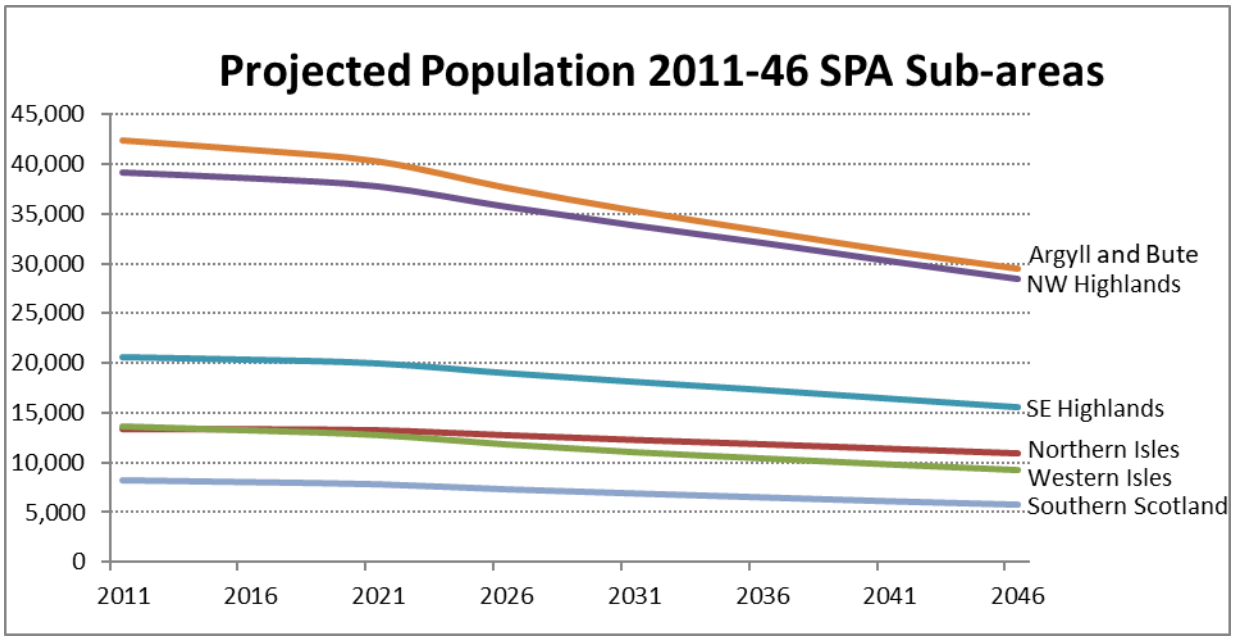
Table 1: Projected Population of the SPA and its sub regions 2011-2046

Population	2011	2016	2021	2026	2031	2036	2041	2046
Northern Isles	13,430	13,410	13,300	12,790	12,290	11,830	11,350	10,860
Western Isles	13,580	13,190	12,720	11,800	11,030	10,410	9,810	9,250
NW Highlands	39,210	38,630	37,800	35,740	33,840	32,080	30,220	28,400
SE Highlands	20,600	20,350	19,970	18,990	18,110	17,270	16,390	15,510
Argyll and Bute	42,440	41,510	40,330	37,680	35,380	33,340	31,340	29,530
Southern Uplands	8,270	8,090	7,870	7,360	6,930	6,530	6,130	5,780
Scottish SPA	**137,540**	**135,180**	**131,997**	**124,357**	**117,580**	**111,470**	**105,240**	**99,350**

Note: All figures rounded to the nearest 10 persons. Sub-areas may not sum to the SPA due to rounding.

[8] It was not feasible to use data from the SCAP area projections due to insufficient detail in the online tables.
[9] https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/migration/migration-statistics/total-migration-to-or-from-an-area
[10] Estimated from the NRS spreadsheet "Migration to and from administrative areas by sex", available from the same web page as above.

Figure 1: Projected population of the SPA Sub-regions 2011-2046



Comparison with the SCAP-based projections

The projected population change for the SPA as a whole, based upon output area data (i.e. the exact boundary), yields similar results to that of the SCAP-based approximation presented in our second working paper (Hopkins and Copus, 2018). For 2016 the SPA projections are slightly more optimistic than the SCAP-based estimates, suggesting an 8% decline after 2011. For 2036, both projections anticipate that the decline will equate to 15% of the 2011 population (Table 2).

Table 2: SCAP and SPA projected total populations (2011=100) in 2026, 2036 and 2046

	SCAP Projections		SPA Projections		
	2026	**2036**	**2026**	**2036**	**2046**
			2011=100		
Northern Isles	102	101	95	92	88
Western Isles	85	73	87	81	77
NW Highlands	95	88	91	86	82
SE Highlands	105	107	92	88	84
Argyll and Bute	83	72	89	83	79
Southern Uplands	94	88	89	84	79
Scottish SPA	**92**	**85**	**90**	**85**	**81**

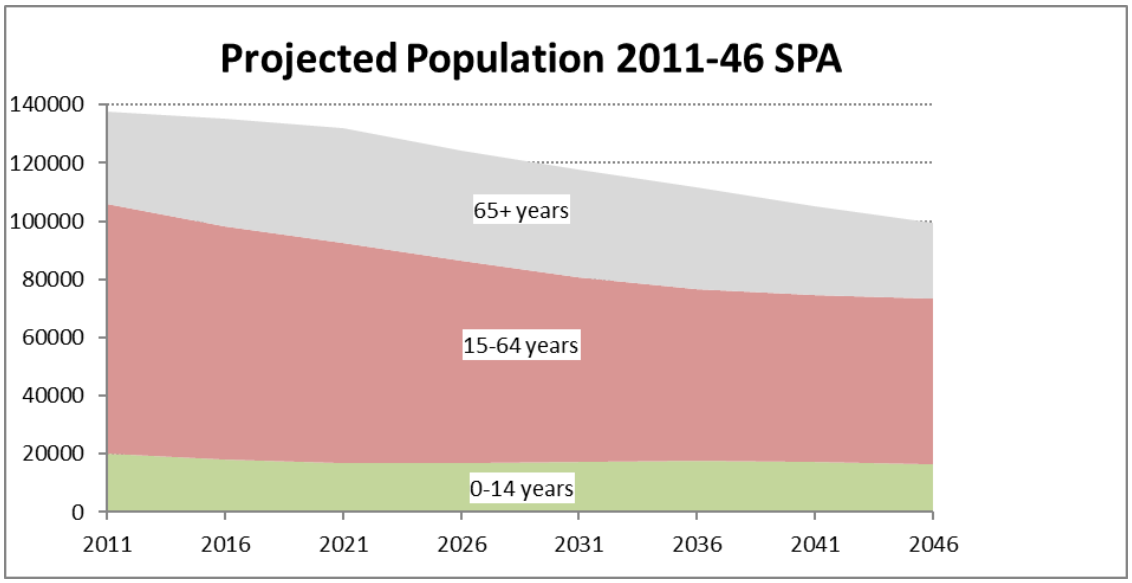
However, it is striking to observe that the SPA projections (unlike the SCAP-based estimates) yield negative trends for all the SPA sub-regions. In the case of the Northern Isles the very small population increases predicted by the SCAP estimates are replaced by population declines of 5% by 2026, 8% by 2036 and 12% by 2046. The discrepancy is probably due to the SCAP area's inclusion of non-SPA populations around Lerwick and Kirkwall. Similarly, the SCAP-based estimates for the SE Highlands include some areas relatively close to Inverness. As a result, the increases suggested by

the SCAP-based projections are reversed in the SPA projections, the area losing population almost as rapidly as the SPA as a whole. On the other had the SPA projections suggest slightly less pessimistic trends for the Western Isles and Argyll and Bute.

The squeezing of the working age population and rising dependency rates

When the projected trend for the SPA is disaggregated by age group (Figure 2) it appears that the largest decline will be in the working age population. Across the SPA as a whole this economically active age group is predicted to decline by approximately one third by 2046 (Table 3), whilst the numbers of children[11] and pensioners are projected to decline by 19% and 18% respectively. As a result, the dependency ratio is set to rise from 0.60 to 0.74.

Figure 2: The Age Structure of Projected Population of the SPA 2011-2046



However, the pattern is less clear-cut in the individual sub-regions. For example, in the Northern Isles the pensioner age group is forecast to increase by 2%. One possible explanation for this is the ageing of in-migrants who have arrived during the years when the oil industry was a significant employer. However, despite some local variation due to various legacy effects in the sub-region populations it is still true to say that the dependency rate is likely to be higher in 2046 in all parts of the SPA. Furthermore, in all the sub-regions, except the Northern Isles, the working age population is projected to shrink by more than 30%. This is clearly a serious issue, if left un-addressed, in terms of the future economic development of the SPA.

[11] Children are defined as 15 years or younger – rather than the conventional 0-16, due to the requirement of the model for five year age groups.

Table 3: Percentage Change in Population 2011-2046 by SPA sub-region and by broad age group

	Percentage Change 2011-2046				Dependency Rate	
	0-14	15-64	65+	All Ages	2011	2046
Northern Isles	-19	-26	2	-19	0.58	0.73
Western Isles	-21	-36	-28	-32	0.62	0.71
NW Highlands	-21	-35	-11	-28	0.58	0.76
SE Highlands	-21	-31	-9	-25	0.58	0.72
Argyll and Bute	-18	-34	-27	-30	0.63	0.73
Southern Uplands	-9	-35	-30	-30	0.62	0.73
Scottish SPA	-19	-33	-18	-28	0.60	0.74

How many migrants are required to stabilise the SPA population? The Equilibrium Migration Requirement

One of the big advantages of using the SPA projection model is that it is very easy to change the assumptions regarding future migration, in order to explore the effects of different scenarios regarding flows into or out of the SPA area. This facility will be very important later in our project, when we intend to explore "feedback effects" of possible changes in economic activity within the SPA. More immediately it allows us to estimate how much net migration would be required to stabilise the population of the SPA and its sub-regions.

Table 4: Annual Net Migration Requirement required to halt shrinkage in the SPA and Sub-Regions 2016-2046 (persons)

	2011-15	2016-20	2021-25	2026-30	2031-35	2036-40	2041-46
				Persons			
Northern Isles	5	21	95	87	78	85	86
Western Isles	65	77	157	125	96	97	95
NW Highlands	112	151	374	333	304	333	335
SE Highlands	54	73	184	158	147	161	163
Argyll and Bute	159	189	445	357	308	308	276
Southern Uplands	37	42	93	77	71	74	66
Scottish SPA	**432**	**553**	**1,348**	**1,137**	**1,005**	**1,058**	**1,021**

During the 2011-15 period, population decline across the SPA could (according to the model) have been halted by a net migration of about 430 persons into the area each year. This is a little over 3 persons per 1,000 of the total population. We may term this the Equilibrium Migration Requirement. It assumes that the age structure of the migrant group would be the same as that of the base period from which the migration rates of the model are derived (2014-16). The Equilibrium Migration Requirement rises to about 550 (4 per 1,000) in the early 2020's, and then to more than 1,300 (10 per 1,000) in the second half of the decade. In the first half of the 2030s the deficit falls back to 1,100 (8.5 per 1,000), and then settles back to a little over 1,000 (9.5 per 1,000) for the remainder of the projection period. This pattern of development is a consequence of the initial age structure, together with the progressive modification of the age structure due to migration, and the effect of both upon fertility and mortality.

Table 5: Annual Net Migration Requirement required to halt shrinkage in the SPA and Sub-Regions 2016-2045 (per 1,000)

	2011-15	2016-20	2021-25	2026-30	2031-35	2036-40	2041-46
	Per 1,000 persons						
Northern Isles	0.35	1.60	7.15	6.80	6.36	7.16	7.60
Western Isles	4.82	5.81	12.37	10.63	8.74	9.35	9.63
NW Highlands	2.86	3.92	9.90	9.32	8.98	10.37	11.10
SE Highlands	2.64	3.57	9.19	8.30	8.13	9.33	9.95
Argyll and Bute	3.74	4.56	11.03	9.47	8.70	9.25	8.80
Southern Uplands	4.44	5.18	11.85	10.53	10.31	11.37	10.71
Scottish SPA	**3.14**	**4.09**	**10.21**	**9.15**	**8.55**	**9.49**	**9.70**

The net migration requirements for the sub-regions tell an interesting story: The highest rate at the beginning of the period (almost 5 per 1,000) relates to the Western Isles. The Southern Uplands and Argyll and Bute also have relatively high rates. By the 2040s all the sub-regions have rates of more than 7.5 per 1,000. In top position is the NW Highlands, followed by the Southern Uplands. The Western Isles has fallen to fourth place. The Northern Isles consistently has the smallest (relative) net migration requirement, throughout the projection period. The changing positions of the six sub-regions illustrate the slow-running dynamics of their population systems.

5. Implications for the demographic narrative of the SPA 2011-46.

In our second working paper we sketched out a narrative of population change in the SPA which began with steady decline in the 1990s, followed by brief recovery in the early years of this century. This brief positive phase seems to have come to an end in 2007 or 2008, when "shrinkage" resumed. An added dimension of this story is the way in which an age structure which was a legacy of decades of age selective out-migration rendered the population structure incapable of reversing this decline. The only prospect of recovery or growth depends upon substantial in-migration of persons of child-bearing age.

The projections described in this working paper tend to corroborate the above narrative, although the greater accuracy in terms of geographical definition has resulted in some differences at the sub-region level. More specifically the SPA projections suggest that the SCAP-based projections were too optimistic for the Northern Isles and the SW Highlands subregions, due to the inclusion of population from the non-SPA areas around Lerwick, Kirkwall, and Inverness.

By studying Equilibrium Migration Requirements we have established population stability in the SPA would require net migration of from 500 to 1,000 persons a year. In terms of rates per 1,000 some sub-regions would seem to require about 10 migrants per year, although this varies between region and across the projection period. To put this into perspective, such net migration rates are only currently found in council areas such as Edinburgh, Midlothian, and Stirling[12].

[12] See footnote 7

6. Some Initial Observations about Policy Implications

The findings described above reinforce those of the second working paper (Hopkins and Copus, 2018), which will not be repeated here. They add emphasis to the severity of the demographic legacy issues facing the Scottish SPA. In broad terms they raise issues in relation to both mitigation and adjustment.

The mitigation challenge is striking in its severity. Clearly the SPA's population is currently in a negative spiral of decline. It would seem that the only way to achieve stability at current population levels would be to find a way to stimulate net migration rates which are currently only achieved in the larger cities and towns of the Central Belt. However, although this seems an unrealistic goal, it is important that the current population is relatively small in absolute terms, and that the (net) number of migrants required (500-1000) across the SPA is modest. Some degree of mitigation (if necessary short of full stabilisation) would clearly be worth considering.

Placing the SPAs demographic sustainability within a wider context, another very obvious policy implication is that a single rural policy, applied to both the SPA and to more accessible rural areas, where the population has in recent years been growing, and where age structures are such that the equilibrium migration requirement is modest, is not appropriate. The issues faced by the SPA, in relation to sustaining economic activity, protecting the environment, and maintenance of services, are very different from those of per-urban areas. Differentiated rural policy is long overdue.

Of the four key policy issues noted at the end of Working Paper 2 (Hopkins and Copus, 2018), the last (referring to critical mass for community development) is particularly underlined by the findings of our projections. This is not only because the projections indicate that the population of the SPA will continue to decline, reducing the human and social capital resource for endogenous growth, but because of the potential implications of mitigation. Migration on the scale required to ameliorate the rate of depopulation of the SPA area would likely present challenges in terms of integration with respect to culture, tradition and community cohesion. Of course, this is not to say that the effects would be predominantly negative. However, this is an aspect that would justify further research, and consideration by policy makers.

Other aspects of adjustment were already mentioned in our previous working paper. They include the implications for the rural economy, and key sectors such as farming/crofting, and tourism; the effects upon land use and land management, and upon the environment and ecosystems of the region; and the consequences for the various services which are required by the resident population and businesses?

References

Norgård Aase, K., Tønnessen M and Syse A (2014). The Population Projections; Documentation of the BEFINN and BEFREG models, Statistics Norway, Oslo. [https://www.ssb.no/en/befolkning/artikler-og-publikasjoner/_attachment/182766?_ts=146956adcb8 accessed 23rd January 2018]

Copus, A. and Hopkins, J. (2017) *Outline Conceptual Framework and Definition of the Scottish Sparsely Populated Area (SPA)*. Working Paper 1 of RESAS RD 3.4.1, available at http://www.hutton.ac.uk/research/projects/demographic-change-remote-areas

Franzen M and Karlson T (2010) Using national data to obtain small area estimators for population projections on subnational level. Work session on demographic projections Lisbon, 28-30 April 2010, Eurostat, Luxembourg. [https://dspace.uevora.pt/.../Work%20Sessions%20on%20Demographic%20projections accessed 23rd January 2018]

Hopkins J and Copus A K (2018) *A Demographic Profile of the Scottish Sparsely Populated Area (SPA) 1991-2037*, Working Paper 2 of RESAS RD 3.4.1, available at http://www.hutton.ac.uk/research/projects/demographic-change-remote-areas

National Records Scotland (2014) Population Projections for Scottish areas *(2012-based)*. Edinburgh. [https://www.nrscotland.gov.uk/files//statistics/population-projections/2012-based-subnational/pop-proj-scot-areas-2012.pdf accessed 23rd January 2018]

National Records Scotland (2016) *Population and Household Projections for Scottish Sub-Council Areas (2012-based)*. Edinburgh [https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-projections/population-and-household-sub-council-area-projections Accessed 16th May 2017]

Annex 1: Specification of the Projection Model

Table A1: Base year (2011) population

Males	N.Isles	W.Isles	N.W.Hland	S.E.Hland	Argyll	S.Uplands	SPA
0 to 4	367	332	897	428	903	136	3,063
5 to 9	341	320	986	512	1,046	187	3,392
10 to 14	437	384	1,116	598	1,154	222	3,911
15 to 19	411	388	1,097	588	1,157	194	3,835
20 to 24	326	328	831	500	947	196	3,128
25 to 29	305	261	759	516	876	162	2,879
30 to 34	351	250	776	399	819	145	2,740
35 to 39	347	386	903	515	1,039	200	3,390
40 to 44	441	514	1,309	751	1,366	252	4,633
45 to 49	555	546	1,637	831	1,612	334	5,515
50 to 54	522	559	1,664	823	1,575	294	5,437
55 to 59	523	521	1,660	725	1,549	362	5,340
60 to 64	608	619	1,756	933	1,852	433	6,201
65 to 69	439	473	1,450	685	1,576	338	4,961
70 to 74	376	406	1,029	538	1,321	254	3,924
75 to 79	228	265	705	395	912	189	2,694
80 to 84	143	185	457	260	538	126	1,709
85 to 89	68	93	256	134	308	62	921
90 and over	29	23	81	64	88	22	307
Total	**6,817**	**6,853**	**19,369**	**10,195**	**20,638**	**4,108**	**67,980**
Females	**N.Isles**	**W.Isles**	**N.W.Hland**	**S.E.Hland**	**Argyll**	**S.Uplands**	**SPA**
0 to 4	342	300	866	420	146	850	2,924
5 to 9	323	332	951	492	184	918	3,200
10 to 14	421	360	1,074	594	213	1,080	3,742
15 to 19	371	357	957	498	212	1,037	3,432
20 to 24	252	219	669	414	149	855	2,558
25 to 29	300	242	723	455	146	856	2,722
30 to 34	326	294	809	413	142	817	2,801
35 to 39	368	377	1,034	565	180	1,122	3,646
40 to 44	481	473	1,370	788	283	1,541	4,936
45 to 49	486	505	1,740	875	308	1,708	5,622
50 to 54	513	502	1,685	806	322	1,626	5,454
55 to 59	502	507	1,708	773	389	1,691	5,570
60 to 64	501	546	1,730	861	394	1,944	5,976
65 to 69	469	438	1,347	681	303	1,631	4,869
70 to 74	340	435	1,057	578	269	1,381	4,060
75 to 79	249	336	842	474	224	1,097	3,222
80 to 84	184	252	642	372	162	826	2,438
85 to 89	113	169	395	246	85	503	1,511
90 and over	71	80	246	104	54	324	879
Total	**6,612**	**6,724**	**19,845**	**10,409**	**4,165**	**21,807**	**69,562**

Source: Population Census 2011 (aggregation of SPA output areas).

Table A2: Fertility Rates in first projection period (births per 1,000)

Age Group	N.Isles	W.Isles	N.W.Hland	S.E.Hland	Argyll	S.Uplands
15 to 19	20.71	20.99	20.61	19.59	21.17	21.91
20 to 24	60.44	61.23	60.14	57.15	61.78	63.92
25 to 29	97.21	98.49	96.73	91.93	99.37	102.81
30 to 34	110.57	112.03	110.02	104.56	113.03	116.94
35 to 39	60.03	60.82	59.73	56.76	61.36	63.48
40 to 44	11.57	11.72	11.52	10.94	11.83	12.24
45 to 49	1.38	1.40	1.37	1.31	1.41	1.46
TFR	**1.81**	**1.83**	**1.80**	**1.71**	**1.85**	**1.91**

Source: National Records Scotland (2014) Population Projections for Scottish areas (2012-based). Edinburgh. Annex A and Annex C. The single-year rates for Scotland as a whole (Annex A) were combined with Council Area adjustment factors (Annex C) to produce 5 year average rates for each Council Area in Scotland. Weighted averages of these were calculated for each SPA sub-region, based upon the proportion of SPA population in each Council Area.

Table A3 Percentage change in Fertility Rates (Scotland)

Age Group	2011-15	2016-20	2021-25	2026-30	2031-35	2036-40	2041-45
15 to 19	0.04	-0.08	-0.01	0.00	0.00	0.00	0.00
20 to 24	0.01	0.00	0.00	0.00	0.00	0.00	0.00
25 to 29	0.01	0.01	0.01	0.01	0.00	0.00	0.00
30 to 34	0.03	0.02	0.02	0.02	0.00	0.00	0.00
35 to 39	0.01	0.04	0.04	0.00	0.00	0.00	0.00
40 to 44	0.04	0.06	0.05	0.03	0.00	0.00	0.00
45 to 49	0.05	0.06	0.05	0.03	0.00	0.00	0.00
TFR	0.02	0.01	0.02	0.01	0.00	0.00	0.00

Source: Estimated from National Records Scotland (2014) Population Projections for Scottish areas (2012-based). Edinburgh, Annex A. In the absence of any regional information, these rates of change were applied to all SPA sub-regions.

Table A4: Mortality Rates in the first projection period (deaths per 1,000)

Males	N.Isles	W.Isles	N.W.Hland	S.E.Hland	Argyll	S.Uplands
0 to 4	1.59	2.25	1.86	1.50	1.87	1.57
5 to 9	0.08	0.12	0.10	0.08	0.10	0.08
10 to 14	0.08	0.11	0.09	0.08	0.09	0.08
15 to 19	0.43	0.61	0.50	0.41	0.51	0.43
20 to 24	0.66	0.94	0.77	0.63	0.78	0.65
25 to 29	0.88	1.25	1.03	0.84	1.04	0.87
30 to 34	1.32	1.87	1.54	1.25	1.56	1.30
35 to 39	1.75	2.48	2.04	1.66	2.07	1.73
40 to 44	2.34	3.31	2.73	2.21	2.76	2.31
45 to 49	2.87	4.06	3.35	2.72	3.38	2.83
50 to 54	4.37	6.17	5.09	4.13	5.15	4.31
55 to 59	6.93	9.80	8.09	6.55	8.17	6.84
60 to 64	10.43	14.74	10.80	9.97	11.20	10.03
65 to 69	16.76	23.68	17.35	16.02	17.99	16.11
70 to 74	27.05	38.23	28.01	25.87	29.05	26.01
75 to 79	42.59	60.20	44.10	40.73	45.74	40.96
80 to 84	71.66	101.27	78.83	78.48	89.32	83.22
85 to 89	115.87	163.76	127.47	126.90	144.43	134.56
90 and over	176.12	248.91	193.76	192.89	219.54	204.54
Females	**N.Isles**	**W.Isles**	**N.W.Hland**	**S.E.Hland**	**Argyll**	**S.Uplands**
0 to 4	1.32	1.50	1.53	1.53	1.38	1.36
5 to 9	0.06	0.06	0.07	0.07	0.06	0.06
10 to 14	0.08	0.09	0.10	0.10	0.09	0.09
15 to 19	0.25	0.28	0.29	0.29	0.26	0.25
20 to 24	0.28	0.32	0.33	0.33	0.30	0.29
25 to 29	0.38	0.43	0.44	0.44	0.40	0.39
30 to 34	0.64	0.73	0.75	0.75	0.67	0.66
35 to 39	0.92	1.05	1.06	1.07	0.96	0.95
40 to 44	1.28	1.46	1.49	1.49	1.34	1.32
45 to 49	1.91	2.18	2.21	2.22	2.00	1.97
50 to 54	3.07	3.50	3.56	3.57	3.22	3.16
55 to 59	4.67	5.32	5.41	5.43	4.89	4.81
60 to 64	7.29	8.32	7.31	7.72	7.53	7.98
65 to 69	11.59	13.23	11.62	12.28	11.96	12.68
70 to 74	18.87	21.53	18.92	19.98	19.47	20.64
75 to 79	30.77	35.10	30.85	32.59	31.75	33.66
80 to 84	55.82	63.68	61.80	65.96	63.52	70.16
85 to 89	96.29	109.85	106.60	113.79	109.58	121.03
90 and over	170.55	194.57	188.82	201.54	194.09	214.37

Source: National Records Scotland (2014) Population Projections for Scottish areas (2012-based). Edinburgh, Annex B and Annex C. The single-year rates for Scotland as a whole (Annex B) were combined with Council Area adjustment factors (Annex C) to produce 5 year average rates for each Council Area in Scotland. Weighted averages of these were calculated for each SPA sub-region, based upon the proportion of SPA population in each Council Area.

Table A5: Percentage change in Mortality Rates (Scotland)

Males	2011-15	2016-20	2021-25	2026-30	2031-35	2036-40	2041-45
0 to 4	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
5 to 9	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
10 to 14	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
15 to 19	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
20 to 24	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
25 to 29	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
30 to 34	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
35 to 39	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
40 to 44	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
45 to 49	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
50 to 54	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
55 to 59	-0.20	0.08	0.78	0.64	-0.06	-0.06	-0.06
60 to 64	-0.27	0.13	0.57	0.22	-0.16	-0.16	-0.16
65 to 69	-0.27	0.13	0.57	0.22	-0.16	-0.16	-0.16
70 to 74	-0.27	0.13	0.57	0.22	-0.16	-0.16	-0.16
75 to 79	-0.27	0.13	0.57	0.22	-0.16	-0.16	-0.16
80 to 84	-0.11	0.05	0.40	0.06	-0.21	-0.21	-0.21
85 to 89	-0.11	0.05	0.40	0.06	-0.21	-0.21	-0.21
90 and over	-0.11	0.05	0.40	0.06	-0.21	-0.21	-0.21
Females	**2011-15**	**2016-20**	**2021-25**	**2026-30**	**2031-35**	**2036-40**	**2041-45**
0 to 4	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
5 to 9	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
10 to 14	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
15 to 19	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
20 to 24	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
25 to 29	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
30 to 34	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
35 to 39	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
40 to 44	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
45 to 49	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
50 to 54	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
55 to 59	0.17	0.02	0.54	-0.11	0.17	0.17	0.17
60 to 64	0.15	-0.12	0.51	-0.22	0.14	0.14	0.14
65 to 69	0.15	-0.12	0.51	-0.22	0.14	0.14	0.14
70 to 74	0.15	-0.12	0.51	-0.22	0.14	0.14	0.14
75 to 79	0.15	-0.12	0.51	-0.22	0.14	0.14	0.14
80 to 84	0.00	-0.03	0.28	-0.25	0.23	0.23	0.23
85 to 89	0.00	-0.03	0.28	-0.25	0.23	0.23	0.23
86 to 89	0.00	-0.03	0.28	-0.25	0.23	0.23	0.23

Source: Estimated from National Records Scotland (2014) Population Projections for Scottish areas (2012-based). Edinburgh, Annex B. In the absence of any regional information, these rates of change were applied to all SPA sub-regions.

Table A6: Factors used to calculate weighted averages of Council Area Fertility and Mortality Rates

	N.Isles	W.Isles	N.W.Hland	S.E.Hland	Argyll	S.Uplands
Aberdeenshire				0.20		
Angus				0.15		
Argyll					1.00	
Borders						0.50
Dumfries and Galloway						0.50
Highland			1.00	0.20		
Orkney	0.5					
Perth and Kinross				0.25		
Shetland	0.5					
Stirling				0.20		
Western Isles		1.0				

Source: Author's estimates. No data on the shares of SPA Sub-Region population by Council Area available at the time of writing. These factors may be revised if such data becomes available.

Table A7: In-Migration Rates (per 1,000) in the first projection period by SPA SUB-Region.

(a) In-Migration

Males (IN)	**N.Isles**	**W.Isles**	**N.W.Hland**	**S.E.Hland**	**Argyll**	**S.Uplands**
0 to 4	17.50	22.34	17.55	27.76	20.76	19.64
5 to 9	15.29	14.52	12.81	17.50	13.31	14.39
10 to 14	13.06	8.56	10.36	14.55	8.89	10.63
15 to 19	14.45	13.37	13.88	25.90	12.03	18.09
20 to 24	42.55	42.80	44.68	47.91	26.21	37.80
25 to 29	34.11	35.78	39.69	46.90	29.52	33.80
30 to 34	27.25	30.58	27.08	40.91	26.44	28.80
35 to 39	21.94	22.22	21.31	29.69	19.41	22.44
40 to 44	18.17	14.43	17.01	20.42	14.70	16.40
45 to 49	14.60	12.98	13.49	14.96	11.33	13.24
50 to 54	14.30	14.23	11.63	13.57	11.62	11.86
55 to 59	12.11	11.35	11.93	12.80	11.91	13.09
60 to 64	8.94	11.25	10.27	10.52	10.11	12.34
65 to 69	7.40	8.75	7.92	8.49	7.21	9.98
70 to 74	4.67	4.52	5.18	6.06	4.07	6.79
75 to 79	4.72	3.85	4.11	5.28	3.49	5.47
80 to 84	4.62	5.58	4.50	6.20	3.89	5.62
85 to 89	4.91	3.85	6.75	9.02	5.29	7.19
90 and over	10.67	6.25	8.80	12.04	7.55	10.09
Females (IN)	**N.Isles**	**W.Isles**	**N.W.Hland**	**S.E.Hland**	**Argyll**	**S.Uplands**
5 to 9	15.51	15.68	13.39	17.61	32.49	14.81
10 to 14	13.24	9.24	10.84	14.64	21.71	10.97
15 to 19	14.65	14.43	14.52	26.18	29.37	18.61
20 to 24	43.15	46.20	46.72	48.22	63.99	39.00
25 to 29	34.59	38.62	41.51	47.14	72.08	34.80
30 to 34	27.65	33.02	28.32	41.14	64.56	29.60
35 to 39	22.26	23.98	22.29	29.88	47.39	23.06
40 to 44	18.43	15.57	17.79	20.54	35.90	16.90
45 to 49	14.80	14.02	14.11	15.04	27.67	13.66
50 to 54	14.50	15.37	12.17	13.65	28.38	12.24
55 to 59	12.29	12.25	12.47	12.87	29.09	13.51
60 to 64	9.06	12.15	10.73	10.56	24.69	12.76
65 to 69	7.50	9.45	8.28	8.53	17.59	10.32
70 to 74	4.73	4.88	5.42	6.09	9.93	7.01
75 to 79	4.78	4.15	4.29	5.30	8.51	5.63
80 to 84	4.68	6.02	4.70	6.23	9.51	5.78
85 to 89	4.99	4.15	7.05	9.06	12.91	7.41
90 and over	10.83	6.75	9.20	12.11	18.45	10.41

(b) Out-Migration

Males (OUT)	N.Isles	W.Isles	N.W.Hland	S.E.Hland	Argyll	S.Uplands
0 to 4	-11.36	-14.62	-12.64	-17.37	-16.16	-12.32
5 to 9	-11.02	-11.54	-9.43	-11.74	-11.27	-10.84
10 to 14	-10.77	-14.14	-7.98	-10.82	-10.05	-9.66
15 to 19	-36.10	-43.09	-30.93	-32.80	-21.79	-31.81
20 to 24	-41.21	-56.17	-39.10	-47.12	-30.86	-40.50
25 to 29	-30.39	-38.76	-33.36	-43.94	-35.80	-35.30
30 to 34	-21.93	-23.85	-21.50	-30.42	-25.57	-23.48
35 to 39	-15.10	-16.54	-16.15	-20.96	-16.85	-17.30
40 to 44	-13.08	-13.37	-11.77	-15.31	-12.03	-12.46
45 to 49	-11.75	-10.96	-10.02	-11.88	-10.34	-9.71
50 to 54	-11.07	-12.60	-8.75	-10.76	-9.30	-8.53
55 to 59	-9.05	-10.96	-8.66	-10.44	-8.83	-8.77
60 to 64	-8.46	-7.60	-8.27	-9.01	-7.67	-7.69
65 to 69	-8.41	-7.69	-7.29	-8.22	-6.86	-7.97
70 to 74	-5.02	-6.54	-7.00	-7.06	-5.93	-6.56
75 to 79	-5.41	-5.00	-5.54	-5.92	-5.87	-6.62
80 to 84	-4.13	-4.81	-5.84	-6.21	-6.45	-7.40
85 to 89	-5.41	-2.79	-6.13	-8.17	-6.74	-8.82
90 and over	-3.93	-6.25	-8.75	-9.83	-10.46	-12.63
Females (OUT)	**N.Isles**	**W.Isles**	**N.W.Hland**	**S.E.Hland**	**Argyll**	**S.Uplands**
5 to 9	-11.74	-15.64	-13.36	-17.52	-39.44	-12.68
10 to 14	-11.38	-12.35	-9.97	-11.82	-27.53	-11.16
15 to 19	-11.13	-15.13	-8.42	-10.90	-24.55	-9.94
20 to 24	-37.30	-46.10	-32.67	-33.01	-53.21	-32.79
25 to 29	-42.59	-60.10	-41.30	-47.63	-75.34	-41.60
30 to 34	-31.41	-41.47	-35.24	-44.36	-87.40	-36.30
35 to 39	-22.67	-25.52	-22.70	-30.71	-62.43	-24.12
40 to 44	-15.60	-17.70	-17.05	-21.14	-41.15	-17.80
45 to 49	-13.52	-14.30	-12.43	-15.42	-29.37	-12.84
50 to 54	-12.15	-11.73	-10.58	-11.98	-25.26	-9.99
55 to 59	-11.43	-13.48	-9.25	-10.84	-22.70	-8.77
60 to 64	-9.35	-11.73	-9.14	-10.51	-21.57	-9.03
65 to 69	-8.74	-8.13	-8.73	-9.07	-18.73	-7.91
70 to 74	-8.69	-8.23	-7.71	-8.27	-16.74	-8.23
75 to 79	-5.18	-7.00	-7.40	-7.11	-14.47	-6.74
80 to 84	-5.59	-5.35	-5.86	-5.97	-14.33	-6.78
85 to 89	-4.27	-5.15	-6.16	-6.26	-15.75	-7.60
90 and over	-5.59	-2.98	-6.47	-8.26	-16.46	-8.98

Source: Derived from the spreadsheet "Migration to and from administrative areas by age", available from the NRS website at: https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/migration/migration-statistics/total-migration-to-or-from-an-area. Steps in the estimation: 1 Estimate rates per thousand for each council area using data in sheet "Migration 14-16 as a % of MYE". 2. Separate male and female shares using ratios calculated from spreadsheet "Migration to and from administrative areas by sex" (downloaded from web page above). 3. Calculate weighted average of rates for each SPA Sub-region, using the factors shown in Table A6.

Table A8: Percentage change in migration rates in each successive five year projection period

	N.Isles	W.Isles	N.W.Hland	S.E.Hland	Argyll	S.Uplands
In	-0.04	-0.11	-0.10	-0.04	-0.08	-0.06
Out	-0.02	-0.04	-0.03	0.01	-0.03	-0.05

Source: Derived from the spreadsheet ""Migration to and from administrative areas by sex"", available from the NRS website at: https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/migration/migration-statistics/total-migration-to-or-from-an-area. Steps in the estimation: (1) Calculate average in/out migration over the periods 2001-05 and 2011-15 for all Council Areas. (2) Calculate % change between the two periods and multiply by 0.5. (3) Calculate weighted average of Council Area rates for each SPA Sub-Area using factors shown in Table A6.

Annex 2: Key Projection Results by Sub-Region

Demographic Foresight Model

Northern Isles SPA

Version 1 January 2017

Andrew Copus
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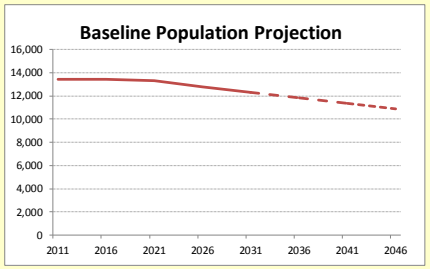
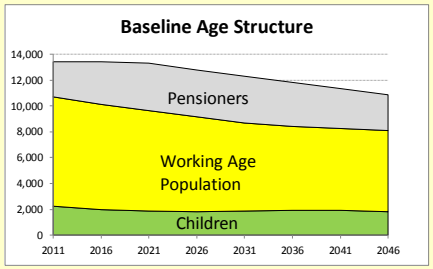
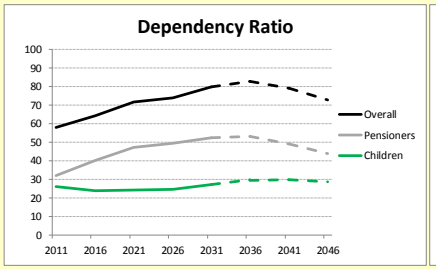
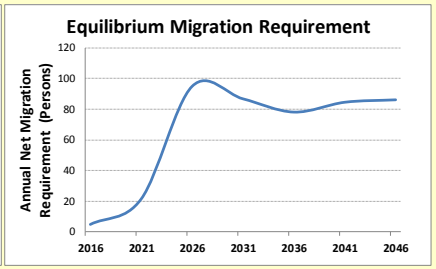
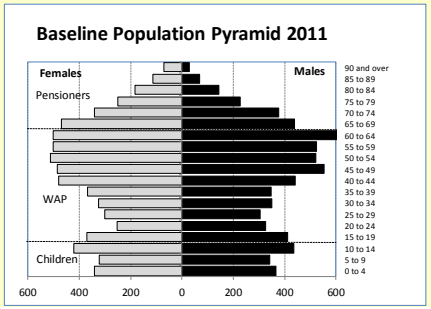
The development of this model was funded by the Rural & Environment Science & Analytical Services Division of the Scottish Government.

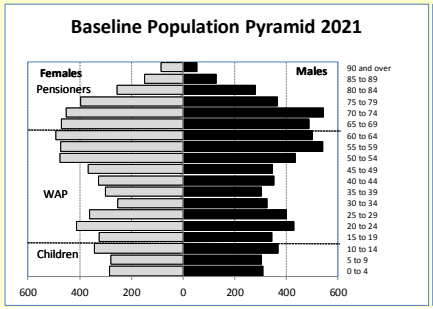


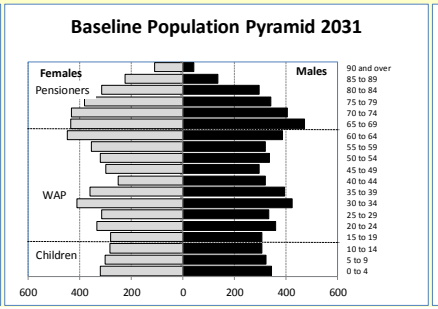


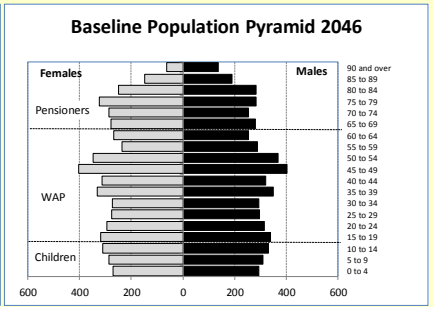












Demographic Foresight Model

Western Isles SPA

Version 1 January 2018

Andrew Copus
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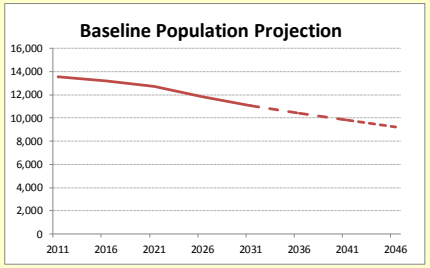

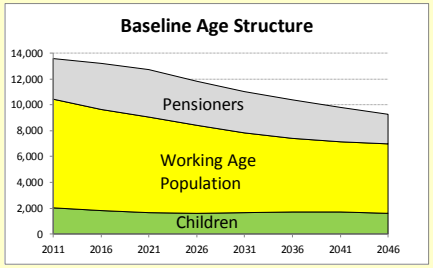

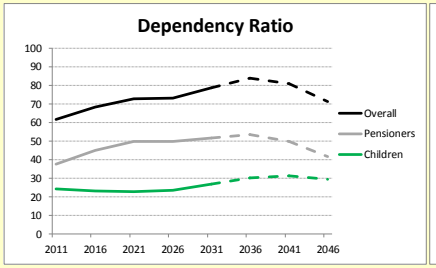

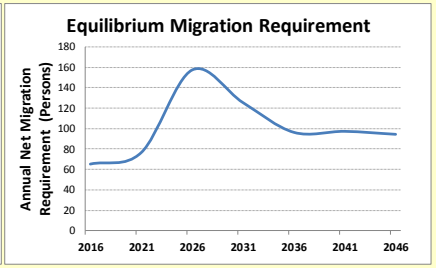

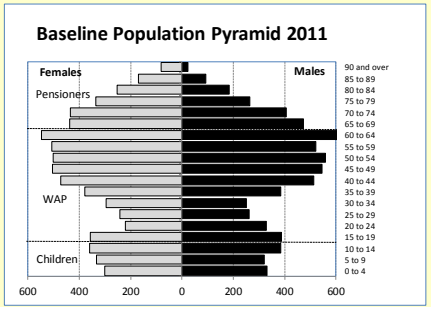

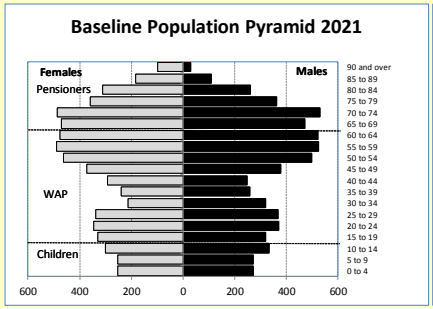

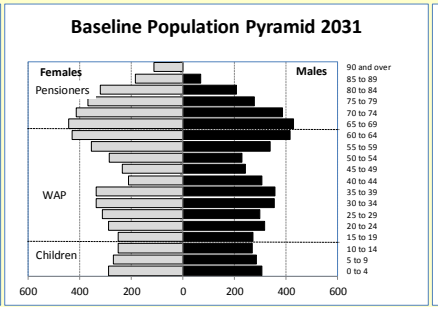

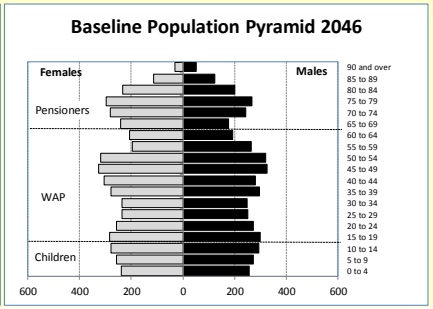

Demographic Foresight Model

NW Highlands SPA

Version 1 January 2018

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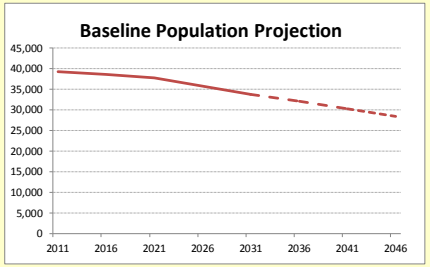

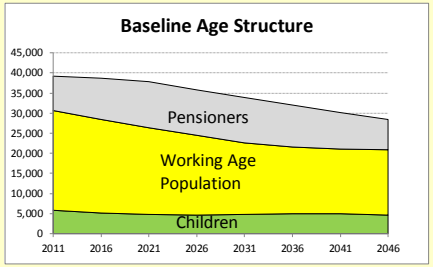

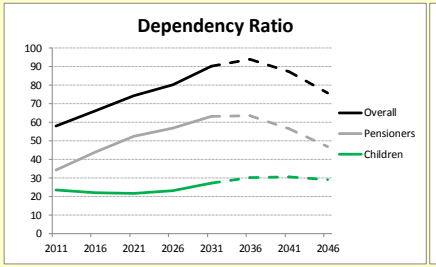

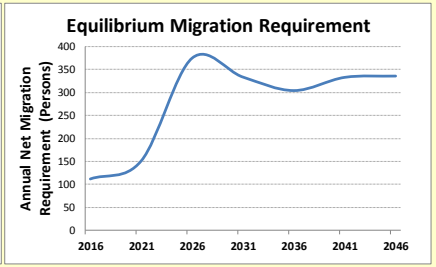

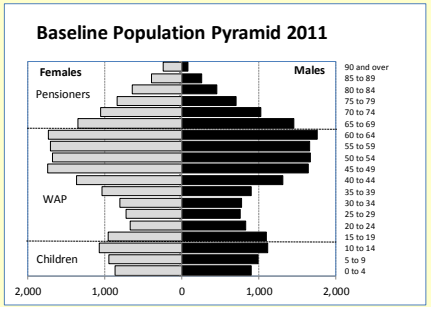

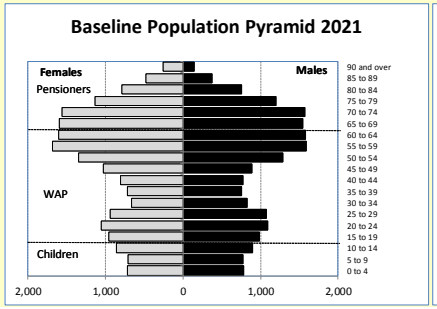

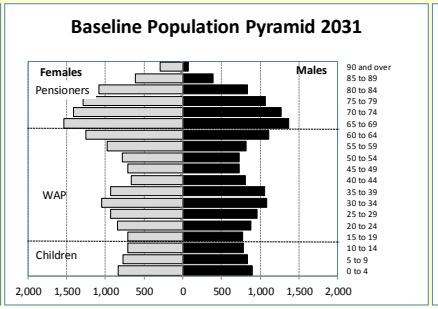

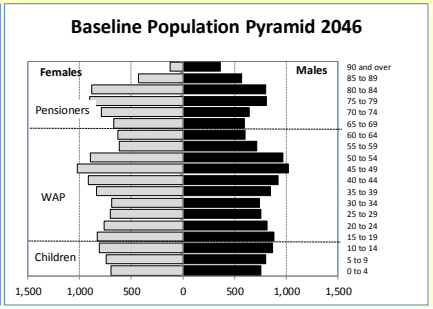

Demographic Foresight Model

SE Highlands SPA

Version 1 January 2018

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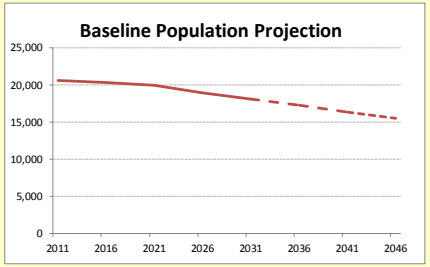

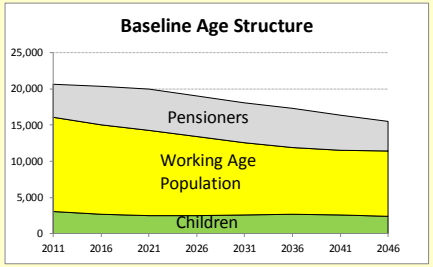

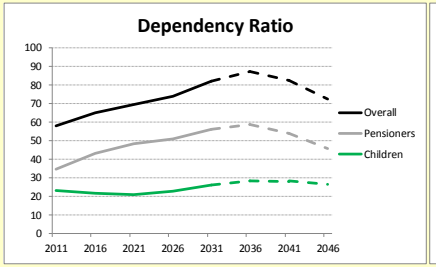

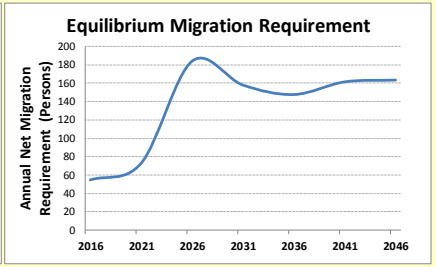

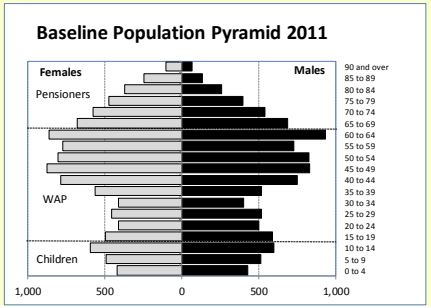

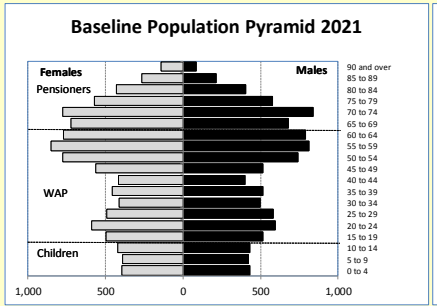

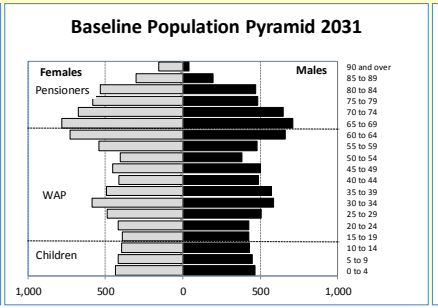

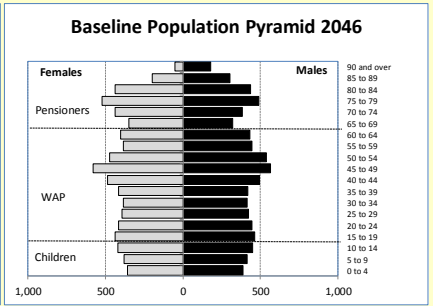

Demographic Foresight Model

Argyll and Bute SPA

Version 1 January 2018

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Social Economic and Geographical Sciences Group, The James Hutton Institute, Aberdeen

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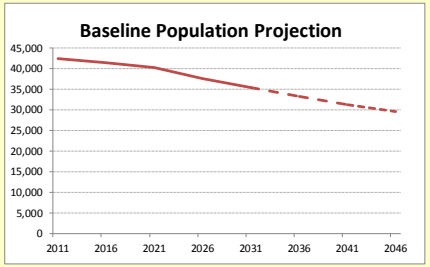

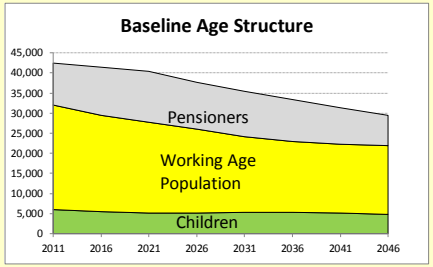

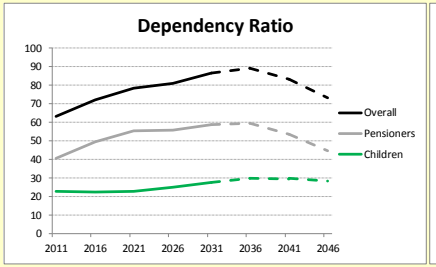

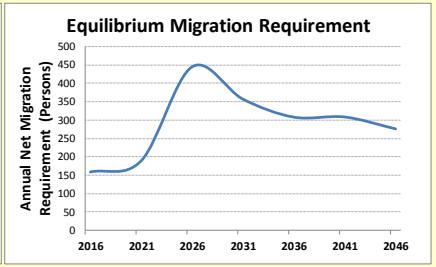

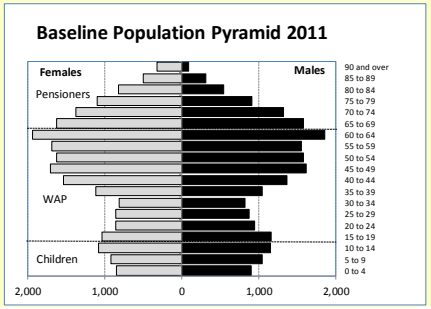

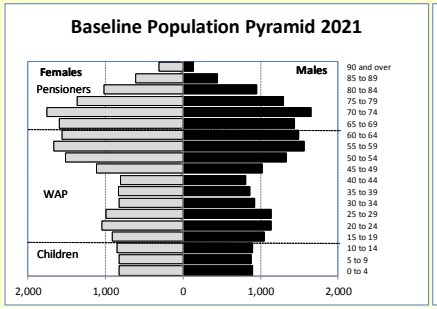

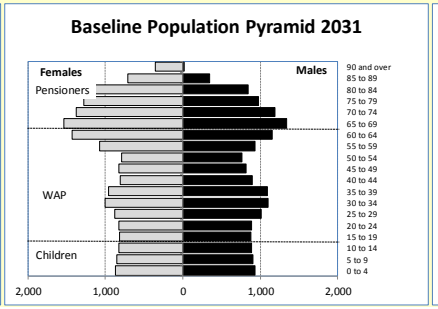

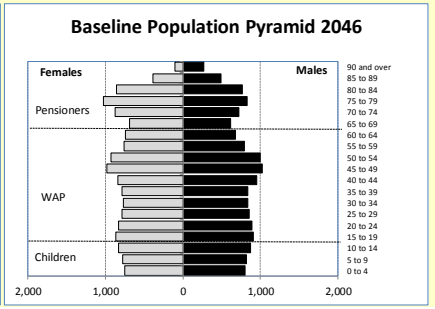

Demographic Foresight Model

Southern Uplands SPA

Version 1 January 2018

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