Historical Demography, Oral History, Settlement Archaeology, and Landscape Ecology: The North Orkney Population History Project

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Abstract:
Between 1750 and 2000, the northern islands of Orkney (Scotland) underwent a major cycle of population growth and decline. The modern demographic transition, which contributed significantly to population decline over the past century, was atypical in several respects: it was late, the decline in fertility preceded that in mortality, and the transition involved massive net out-migration, resulting in progressive depopulation.

The North Orkney Population History Project is investigating these demographic changes within the context of the transition from near-subsistence farming to modern, commercialized livestock rearing. Unusual for historical demography, we are linking parish records, census data, and vital registers to historical archaeological information on houses, farmsteads, and the past environment, and ethnographic/oral history material on local people's perceptions of change over the past 80 years.

Using data from the islands of Westray and Sanday, we compare the spatial distribution of households using multi-scale point pattern analysis to ascertain the extent to which surviving archaeological remains can capture the historically documented settlement pattern of the pre-modern demographic regime. We link archaeologically-surveyed farmsteads to decennial censuses (1851 to 1901) to determine whether household size and composition are reflected in the physical remains of abandoned farmhouses. We also map the spatial distribution of kinship-based social networks, which have already been shown to be important determinants of early childhood mortality and birth spacing during the pre-modern period. Finally, we place the spatial distribution of farmsteads in their environmental context using information from remote sensing, land-productivity surveys, field-walking, and old cadastral and OSGB maps.

Introduction/Overview:

Between 1750 and 2000, the northern islands of Orkney (Scotland) underwent a major cycle of population growth and decline. After several hundred years of a likely stable population regime, the islands experienced significant population growth between 1780 and 1850, followed by severe population decline. The modern demographic transition in Orkney, which contributed to this population decline over the past century, was atypical in several respects: it was late, even by northern Scottish standards, the decline in fertility preceded that in mortality, and the transition was accompanied by massive net out-migration, all of which led to progressive depopulation of the islands.

The *North Orkney Population History Project* is attempting to understand these population dynamics within the context of the transition from near-subsistence farming to modern, commercialized livestock rearing. Unusual for historical demography, we are linking parish records, census data, and vital registers to historic archaeological information on houses, farmsteads, the past environment, and ethnographic/oral history material on local people's perceptions of change over the past 80 years or so.

In this paper, we use a sub-sample of data from the islands of Westray and Sanday to compare the spatial distribution of households using multi-scale point pattern analysis in order to ascertain the extent to which surviving archaeological remains (informed by demographic data) can capture the historically documented settlement pattern of the pre-modern demographic regime. We link archaeologically-surveyed farmsteads to decennial censuses (1851 to 1901) to document the extent to which household size and composition are reflected in the physical remains of abandoned farmhouses (a fundamental problem in archaeological estimation of past population size). We also map the spatial distribution of kinship-based social networks, which have already been shown to be important determinants of early childhood mortality and birth spacing during the pre-modern period (Sparks, 2007). Finally, we place the spatial distribution of houses and farmsteads in their landscape context using information from

remote sensing (satellite imaging, aerial photography), land-productivity surveys, field-walking, and old cadastral and OSGB maps.

More generally, we offer that traditional approaches to historical demography, which rely more or less exclusively on written documents, can be narrow and produce demographic reconstructions that are radically decontextualized. Conversely, we believe that information from historical demography can be more effectively integrated into anthropological and archaeological research. Simply, we assert that combining historical demographic research with methods and models from such fields as landscape archaeology, settlement archaeology, spatial analysis, and oral history is likely to deepen our understanding of past population dynamics.

Background/Context:

Our project investigates the spatiotemporal processes of demographic and economic change in northern Orkney from c. 1735 to the present (the period of interest is determined primarily by the availability of written records needed for demographic reconstruction). The islands included in our study (Westray, Papay, Faray, Eday, Sanday and North Ronaldsay) form a natural cluster north of Mainland Orkney where the North Sea and the North Atlantic meet **(Figure 1)**. A total of about 1300 people inhabit the islands today, substantially fewer than the peak population of 6062 in 1861**(Figure 2)**. Today, settlement is somewhat discontinuous, with individual homes and farmsteads scattered across the landscape **(Figure 3)**. Villages or towns are present on the two largest islands, Sanday and Westray, but today one would characterize the islands as dispersed and rural. Over the years, inhabited farmsteads have been improved but the great majority of modern farms are located on *(Old Norse)* named farm sites that predate the eighteenth century. Additionally, abandoned farms, inhabited up until the the 20th century, still contain original farm buildings and farm features in various states of archaeological preservation. In the last several centuries, individuals and families were relatively mobile, but farmsteads appear to have been remarkably stable. And since farm names were used regularly in censuses, vital registers, rentals, tax rolls and other old documents, we can trace the movement of families across the landscape with

relative ease for the entire period of our study. Therefore, our project is set within an unusually well characterized spatial framework that allows us to look beyond traditional questions posed by historical demography and better interpret the spatial dynamics of population history in Orkney. Additionally, these conditions allow us to tackle broader anthropological and archaeological questions.

Until recently, agricultural production in Orkney was geared to meet household needs, including rent. This system relied on a delicate balance of grain production and livestock raising. And while the 'spatial dynamics' of agricultural production changed significantly in the 19th century, the core techniques and products did not change from the early medieval period until (one could argue) the mechanization of agriculture in the 20th century **(Figure 4)**. However, significant reorganization of the spatial dynamics of agriculture took place in the 19th century, which made that delicate balance increasingly fragile and likely contributed to a reorganization of labor on the islands and subsequent population decline. This reorganization was partly a result of a previous period of economic growth that began in 1780. This economic boom, driven by kelp collection and processing, provided alkali for the British glass, soap, and dye-making industries on a 'commercial scale' **(Figure 5),** but required a large labor pool. Due to this economic impetus, much of Orkney experienced a near doubling of population between 1780 and 1830 (Thomson 1983, 2001). Some of this population growth can be attributed to in-migration, but there is evidence to suggest it may have involved changes in fertility and mortality (not to be discussed here) (Sparks 2007:6). The kelp boom persisted in Orkney until 1830, wherein the British government lifted several tariffs on the importation of alkali from Spain and other countries, sending the price of kelp spiraling in Orkney and leaving the islands with large pools of labor on a relatively un-intensive agrarian landscape. And while our project is focused on the recent 300 year history of Orkney, our paper here relies on data gathered for the period after the kelp boom and during agricultural reorganization, (ca 1840 to 1900).

After the kelp boom crash, landlords struggled for a couple of decades to manage their lands without any viable export. Following reorganization principles from

mainland Scotland and beginning around 1840 landlords initiated a substantial period of farm reorganization, enclosure of common pasture, construction of new drainage systems and a general intensification of production (Sparks 2007) **(see figure 4)**. This period was accompanied by moderate population growth, until 1880 when prices of grain and cattle experienced a downturn. From 1880 until today, the northern islands have witnessed severe depopulation **(see figure 2)**. So while the demographic changes between 1850 and 1900 are a part of larger patterns of population growth and decline, we are particularly interested here in the spatial dynamics of these patterns during the period wherein these agrarian changes occurred.

1851 – 1901 North Orkney Population History
(for a more complete description see Sparks 2008)

The period of 1851 to 1901 is a period of significant change for the inhabitants of the northern isles. On the heels of the kelp boom and contemporaneous with agricultural reorganization, all islands exhibit moderate population growth from 1851 to at least 1871 **(table 1)**. Some islands experience very modest growth as late as 1881. But beginning in 1871, the overall population of the northern isles begins to decline. The decline occurs at varying rates as exhibited here by population density and growth rates **(tables 2 and 3)**. The significant declines begin at the turn of the century, leaving all islands with less than 10 persons per km^2. Some of the islands are completely abandoned **(see Faray in table 1)**. The structure of the population, exhibited by age and gender echo these patterns, but clearly demonstrate patterns consistent with a declining population due to out migration, ultimately leading to a decrease in the fertility of the population **(Figures 7a – 7e)**.

Body/Analysis:

While the above describes the demographic context for the issues we are studying, they are somewhat limited descriptive techniques. The primary purposes of this paper are to introduce what we believe are unique methods for analysis and

interpretation of Orkney's broader demographic history. Instead of simply discussing the unique data collection techniques and analytical methods we are using, we believe it would be more effective to organize our approach by addressing some specific questions about the larger settlement ecology, landscape, and buildings archaeology wherein these demographic patterns are observed. Thusly, our analyses are exploratory as our project shifts from primary data collection to more complete data analysis and interpretation.   Specifically, the purposes of this paper are to address some broader questions, such as:

Question 1: Settlement Patterns

- o Do population dynamics exhibit a broad inter-island spatial pattern?
- o Do the islands' individual patterns differ (spatially, temporally, or organizationally)?

Question 2: Settlement Ecology

- o What natural and cultural factors may contribute to the overall spatial patterns?
- o What factors might contribute to intra-island variability in the above patterns?

Question 3: Settlement Pattern and Landscape Archaeology

- o How do the changing dynamics of household demography influence the patterns of the physical remains of households?
- o Conversely, what physical features of households can be used to better estimate or model population in purely archaeological settings?

Question 4: Experimental Methodological Approaches

- o What photogrammetric techniques can be efficiently applied to non-forested landscapes for rapid acquisition of settlement pattern data?
- o What remote sensing techniques can be applied to better document physical features of the landscape related to agricultural production?

Question 1: Settlement Patterns

First, using point pattern analyses we compare and contrast the spatial distributions of farms and populations on Westray and Sanday. Each of these islands provides a unique environmental context to compare contrast the pattern of settlement ecology between 1851 and 1901 **(figures 8a – 8e)**. Through this analysis we aim to answer the following specific questions:

1. Are the farms (large and small) randomly distributed throughout Sanday and Westray?

    a. Is there a pattern of dispersion or nucleation with the associated population growth and decline from 1851 to 1901?

    b. Does the structure and distribution of the comparative settlement pattern of Sanday differ from that of Westray?

In order to address these primary questions, we are relying on two primary sources of data. First, demographic data analyzed here come from the decennial census returns from Orkney from 1851 to 1901. Second, these data were linked using spatial reference of farm names within a GIS, relying on historic OSGB cadastral maps, historic estate maps, and traditional archaeological survey of farmsteads. We performed a number of simple and weighted point pattern analyses for each of the islands between 1851 and 1901. These analyses include:

1. Simple point pattern analyses, such as nearest neighbor and assorted distance to nearest neighbor methods, and

2. Second – order point pattern analyses.

While these analyses simply test whether the observed population distributions from 1851 to 1901 are non-random, we will refine these analyses to determine what factors lead to any and all non-random observed patterns (see question 2).

Results/Brief Discussion - Question 1

While the data for Westray and Sanday combined are relatively inconclusive, they do demonstrate a pattern of dispersion, a result we expected for preindustrial agrarian settlements with low population densities. However, there does appear to be a significant difference between the populations of Westray and Sanday. The farms on Sanday are more clustered than their counterparts on Westray. The point patterns don't explain why the Sanday farms appear more clustered, but we examine that pattern below and believe that the clustering is correlated to physical features of Sanday's landscape and the specific history of Sanday's agricultural reorganization.

Question 2: Settlement Ecology

Overall, our purpose is to better understand and interpret the spatial patterns influenced by historical demography in the six northern islands of Orkney. Because of that, we are certain that our project can contribute to a large body of settlement pattern theory. Building on the analyses/results presented above, we offer a framework for how we intend to address the question of what landscape variables (natural and cultural) contribute to the structure and distribution of settlement in Orkney from 1735 to the present day. Specifically, we contend that in the preindustrial agrarian system, the most likely influential variables are going to be physical characteristics of the landscape, such as soil, land quality, and access to coastline and social characteristics, such as kin networks and labor requirements. While our analyses are largely exploratory at this point in time, here we address the following specific questions from a sub-sample of the farms on Westray (Rapness):

1. Is rent (valuation) related to the amount of land for each farm?
2. Is rent (valuation) related to the quality of land for each farm?
    a. First, measured as the relationship between grazing land and arable land, and
    b. Second, measured by analysis of estimates of soil productivity.
3. Is farm size or population density related to these measures of productivity?

Results/Brief Discussion - Question 2 (Figures 9a – e)

The data analyzing rent and the quantity and quality of land clearly demonstrate a direct correlation, as expected. The general analyses of soil quality and population density, however, show mixed results. These data are more clearly correlated for the data from Sanday, but we need more fine scaled data for future analyses.

Question 3: Settlement Pattern and Landscape Archaeology

In the absence of records, archaeologists typically rely on some standard measures of households, household architecture, and site size in order to estimate demographic patterns. At this point, we choose not to debate the value and/or significance of such methods, but simply test some traditional archaeological measures using observed historical demographic patterns from the records. We performed the following analyses for Westray between 1851 and 1901.

1. What demographic variables contribute to or best can be used to estimate household size. Taking 1851 – 1901 and comparing the demographic data to the field observations and/or historic cadastral maps. For example:
   - Social Organization (Area of Farms)
   - Household Area vs. Max Population (1851-1901*)
   - Household Area vs. Avg. Population (1851- 1901*)
   - Average Household Size
   - Household Area vs. 1851 – 1901 Population

Results/Brief Discussion - Question 3 (Figures 10a - f)

While the R^2 aren't very strong, the simple correlation of maximum population and average population between 1851 and 1901 show a consistent pattern. Interestingly, number of buildings, traditionally used in archaeology as a means to reconstruct populations did not show a strong correlation. We believe this to be a characteristic of larger social and economic patterns associated with agriculture in Orkney during this time period.

Question 4: Methodological Approaches (Figures 11 – 14)

A secondary goal of our project is to explore experimental techniques that will allow us to more effectively document the landscape history of Orkney's northern islands. Because of the richness of geospatial historic data and demographic data, we are exploring new techniques, primarily remote sensing for documenting and analyzing the historic landscape of Orkney. First, we are using a pole mounted oblique photogrammetric method for documenting historic architecture and landscape features. Second, we are beginning to process historic aerial photos and multi-spectral satellite imagery for better interpreting landscape patterns. The examples presented here demonstrate:

1. Direct Discovery Methods: A combination of historic cadastral geospatial data linked to historic aerial photos to better document and interpret household architecture, gardens, field boundaries, and landscape improvements.

2. Indirect Methods: Using Land Surface Temperature calculated from time series LandSAT imagery to document the spatial patterns of improved fields. Here we believe that lands moving to fallow will be an indirect measure of land quality, not represented in soil surveys. Simply, land that has been left fallow during the past three decades should show a cooler temperature as soil moisture increases.

Conclusion/Discussion:

The specific purpose of this paper was to broaden the approach and applicability of traditional historical demography in order to better understand and interpret the demographic history of northern Orkney. Moreover, we aim to demonstrate that through this approach we can better inform spatial analyses of these data. By combining traditional historical demographic methods, with those of archaeology and ethnography, we aimed to demonstrate such an approach for other settings. Informed

by our overall research, we first described the demographic history of northern Orkney and identified what factors were likely the most significant in influencing the spatial patterns of settlement between 1851 and 1901. Using the two largest islands, we explored several analytical approaches, including first and second order point pattern analysis, to better understand the spatial dynamics of Orkney's population history. We ended by briefly discussing how these data could not only be used to enhance anthropological and archaeological questions of settlement ecology, but also examined some of the experimental techniques we are applying to enhance data collection.

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Figure 14. Land Surface Temperature Calculated from LandSAT

Table 1. Overall Population

Table 2. Population Density

Table 3. Population Growth

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Table 1: Overall Population of Northern Orkney (adapted from Sparks 2007)

Year	Eday	North Ronaldsay	Papa Westray	Faray	Sanday	Westray	Total
1851	944	481	337	67	1892	1791	**5512**
1861	947	526	371	69	2004	2088	**6005**
1871	897	532	392	82	2006	2153	**6062**
1881	822	539	370	83	2053	2090	**5957**
1891	730	547	345	72	2075	2190	**5959**
1901	647	501	337	58	1929	2044	**5516**
1911	592	442	295	47	1727	1817	**4920**
1921	508	436	258	51	1529	1659	**4441**
1931	474	349	247	60	1403	1507	**4040**
1941	430	298	237	60	1160	1249	**3434**
1951	308	224	184	0	866	1080	**2662**
1961	198	161	139	0	670	872	**2040**
1971	179	134	106	0	592	735	**1746**
1981	147	109	92	0	525	701	**1574**
1991	166	92	85	0	533	704	**1580**
2001	121	70	65	0	478	563	**1297**