DISSOLUTION AND FORMATION OF EXTENDED-FAMILY HOUSEHOLDS IN NORTHERN ORKNEY, SCOTLAND, 1851-1901

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Introduction

Historical demographers have long debated the nature of households in past societies, with much attention paid to the categorization of household types and the analysis of their spatial distribution and changes in prevalence over time [1-6]. In the traditional farming system that dominated the economy of preindustrial Orkney in Scotland, households provided the labor needed to produce food and other goods for family consumption. In order to improve their odds of a successful subsistence enterprise, these smallholder households needed to balance the group's current age and sex composition with both current and future food consumption and labor requirements [7-9]. Household composition can be considered an important factor in determining household energy requirements as well as its ability to muster enough labor to produce the goods necessary to satisfy those needs. When considered in conjunction with agricultural resources, such as arable land, to which the household has access, household composition may be an important determinant of the economic and physical well-being of its members, especially at times of stress, such as might be expected during food shortages or the illness or death of family members.

With respect to household forms, extended-family living arrangements, which on average contain more people than simple-family households, may be economically advantageous as they allow for a potentially larger and more diverse labor pool. In addition, extended households may have served several other important functions in this rural island community, including shared farm labor among related households, childcare, and assistance in establishing migration networks. Extended households may have also functioned as social safety nets by which care for infants and the elderly were provided. However, in such cases, additional members may actually represent a net drain on the household's resource base rather than a net gain, making the ratio of producers to consumers less favorable. Indeed, the potential gains of larger, extended families must also be balanced against other concerns, such as overcrowding within dwellings and declining marginal returns on additional labor [9-11]. It is therefore necessary to consider extended-family living arrangements dynamically, with particular attention to changes in household composition, access to land, and land ownership. The study of the dynamic processes of extended household formation and dissolution can therefore provide insight into the potential advantages and disadvantages of these living arrangements.

Although specific systems of household classification have been the subject of debate, it is widely regarded as one of the most important findings in European historical demography that, in northwest European populations of the early-modern to modern period, extended households were very rare. As Peter Laslett (1984:90-91) famously put it,

> [It is commonly held] that our ancestors lived in large familial units. Family groups, it seems to be almost universally agreed, ordinarily consisted in the pre-industrial past of grandparents, children, married as well as unmarried, grandchildren and often relatives, all sleeping together in the same house, eating together and working together.... [If so,] households would have had to be bigger than our households are, and more complicated in their inner relationships as well: extended families is the phrase which is almost always used.
>
> Now all these statements have been demonstrated to be false.... It is not true that most of our ancestors lived in extended families [12].

This may well be true as a loose empirical generalization for northwest Europe as a whole, but may need to be modified as new information on specific localities becomes available. For example, in historical demographic research in the northern islands of Orkney, Scotland, from

1851 to 1901, the authors have encountered numerous cases of what can be called *hidden* household extension – "hidden" in the sense that the documentary evidence does not explicitly identify the household as extended but ancillary information (in this case, from historical archaeological remains and cadastral or OSGB maps) does. These households, which will be referred to as "compound" households, are different from other extended households in several ways, and may have different advantages and drawbacks.

The purpose of this paper is to describe the determinants of the dynamics of household extension in the Orkney setting. These processes will be modeled using event-history methods that will assist us in identifying what other factors influence the odds that a household goes from nuclear to extended or extended to nuclear between census years, after controlling for other household characteristics. In addition to modeling household formation and dissolution, this paper will describe the frequency of family forms in Northern Orkney within the environmental and economic contexts that distinguish this particular case from the rest of northwest Europe.

Background

The Orkney Islands are an archipelago off the coast of northern Scotland, where the North Sea and Atlantic Ocean meet. The six islands of the study are Westray, Sanday, Papa Westray, Eday, North Ronaldsay, and Faray (Figure 1). These islands were selected as part of an ongoing interdisciplinary study of population and family history, settlement, and land use known as the North Orkney Population History Project [13-15].

The northern Orkney Islands were, and have remained, rural in character. Historically, agricultural production relied on grains, mainly black oats and bere (a landrace of barley), and traditional breeds of livestock, including sheep, cattle, chickens, and pigs. These activities supported household subsistence and paid rents, often in kind. Individual farmsteads, or groupings of houses and agricultural buildings associated with gardens and fields, are dispersed over the islands with a few small villages that are slightly more densely settled, but still mainly agricultural in nature. These farmsteads all have names and these names appear in historical records and persist for many generations, even while the inhabitants change over time [16-18]. Cadastral (estate) maps from the decades before the study period, such as the 1830s and 1840s, feature farmsteads with the same names and locations as in later historical and modern maps. Orkney historians speculate that most of the farm and house names became fixed by the 1840s to accommodate record keeping (such as census enumerations and valuation rolls) and mail delivery [18]. The population of the islands reached its height in the mid- to late-1800s, after which out-migration, both to mainland Scotland and overseas, associated with agricultural downturn caused the depopulation that continues to this day. This depopulation, in combination with the widespread use of stone as a building material, have facilitated the survival of archaeological evidence that allows for study of the settlement history of the islands, as well as provides information about the structures present at farmsteads that appear in historical records.

Farmstead names are listed in decennial census returns, along with the inhabitants of the farmstead and their relationship to the household head, such that household composition and type can be determined and tracked over time. For the purposes of this study, household types are defined following the classification system devised by Hammel and Laslett, with one notable exception [3]. The surviving archaeological remains in Orkney provide evidence for a household type not included in the Hammel-Laslett classification that would otherwise go undetected. While demographic data sources suggest that extended households are less common than simple households, the physical remains of household-based farmsteads reveal that many units listed separately in the census were actually extended in the economic sense described by Hammel [7].

These compound households, often linked by brothers, are adjacent, or even structurally joined, and share a common set of essential farming structures such as barns, byres, grain kilns, and stables. Given what has been learned about Orcadian economic and social systems through this interdisciplinary project, the investigators are confident that the component units of such compound households were not independent, but rather cooperatively worked their holdings and shared the products of their labor, even if employed in outside wage labor, which was often part-time or seasonal. By this criterion, the sharing of a single set of farming structures, compound households comprise 26% to 41% of the households in the sample, whereas extended households represent between 18% and 25% of sampled households (Table 1). Compound households, particularly when compared with extended households, provide a good test case for predictions about the economic impetus for forming non-simple households and how landholding size and quality may place an upper limit on household size and degree of extension.

A particular case will serve as illustration. On the island of Westray, there once existed a croft of 1.8 hectares called South Hammer (abandoned in the 1980s and absorbed into a neighboring farm). According to the 1901 UK census, the inhabitants of South Hammer were as listed in Table 2. If that record were the only source of information available, would we code South Hammer as a single extended family or as three more or less independent nuclear-family households? Since a “head” is listed for each of the three units, one might be inclined to call them separate households, especially if we have in mind Laslett’s dictum about extended families being anomalous in this part of the world. Archaeological investigation and detailed mapping, however, suggest we would be wrong. The project’s survey of the physical remains of South Hammer show that the three domiciles were either very close or attached; more importantly, it shows that the entire complex had but one barn, byre, stackyard, kailyard, and muckyard, the minimal structures needed for a *single* farming unit (Figure 3). Moreover, the 1901 OSGB map (Figure 4) shows that the same structures existed contemporaneously with the inhabitants in Table 2. Whatever else they may do, including part-time and seasonal work on other farms or as fishers or craftsmen, crofters are farmers on their own holdings and everyone living at the croft helps with the farming if physically able. Therefore, South Hammer should be regarded as one extended household whose members pool resources as a single farming unit.[1]

By this criterion, household extension is, in accord with Laslett, not ubiquitous in North Orkney but nor is it terribly *rare*, and its frequency varies extensively across islands and periods (Table 1). Why is the frequency of extension in Orkney high when compared to the rest of northwest Europe? And, if household extension is advantageous under some circumstances, why is it not even *more* common? Some recent ideas from Gene Hammel may provide a way to think about these questions [7]. Building upon models of the economics of the household life cycle originally developed by Chayanov [9], Hammel suggests that household extension may dampen unfavorable fluctuations in household consumer/producer (C/P) ratios by combining nuclear-family units at differing phases of their life cycle. While this improvement in C/P ratios may be an impetus for forming extended-family households, in theory there is an important limit to the process that was ignored by Hammel: as households become more extended, they also, generally speaking, become larger. In rural Orkney, allotments of arable and pasture are fixed (at least over a time scale of a few decades) and cannot be expanded as the household grows. It is hypothesized, therefore, that household size should be an important predictor of the dissolution of extended households, at least when controlled for size of holding (both its main effect and in interaction with household size).

[1] Genealogical linkages reveal that the three "heads" in Table 1 are all full siblings who grew up at South Hammer when a single nuclear-family household lived there (Figure 2).

In most cases, precise data on holding size for the farmsteads in Orkney is difficult to obtain. However, records of rents, taken from valuation rolls held in the Orkney Archives in Kirkwall, are available for all holdings. In addition, surviving cadastral maps provide size of holdings in acres for certain estates, and these can be used to validate the rents as proxy measures for size of holding. Indeed, in a sample of holdings given in such maps, it turns out that rents are almost entirely a reflection of the sizes of holdings ($r^2 = 0.98$).[2] The investigators therefore believe that rents are valid proxies for landholding size.

Data and Methods

Three primary data sources are used in this study: vital registration records, individual-level census returns, and valuation rolls. The authors collected these data from the General Registrar of Scotland (GROS) and the Orkney Library and Archive as part of an ongoing study of the population history of the northern Orkney Islands. The decennial censuses provide information on every person at home on the day of enumeration, including age, sex, and conjugal condition. From these returns, the composition of the household is obtained. Information about vital events that occur in each household are taken from vital records of births and deaths, which include the name of the farmstead or house in which the individual was present. These house names, which persist over time, are used to link the census returns to the vital records. Valuation rolls, or records of the taxation or rental value of land and buildings, also list house names, which are again used to link these data to information from the censuses and vital registers. The data

[2] More specifically, the authors regressed rent on amount of arable and pasture (both in acres) and on the interaction between arable and pasture. The regression coefficients were all highly significant and, as noted, the fit was excellent. Other analyses combined data from different estates and included main effects and interactions of lairds (landowners) to test the idea that different lairds were translating acreage into rent using different scales. None of these laird effects was significant. As a result, the authors believe that it is possible to combine rents from different estates without introducing bias.

used in this study represent all households on the islands of Westray, Eday, Papa Westray, and Faray for which such record linkage was possible.

Households were observed at each decennial census interval from 1851-1901. Information about household composition and type is only known from census data so that the events of interest, the formation and dissolution of extended and compound households, are interval censored. Because of interval censoring, discrete-time logit hazard models were used to predict the dissolution or formation of households. In the sample, drawn from the islands of Westray, Papa Westray, Eday, and Faray, 207 extended and 277 compound households were observed. For the purposes of this study, extended households are identified using the criteria outlined in Hammel and Laslett [3]. Households with more than one head listed in the census, such as in the case of South Hammer, are categorized as compound households. Simple households are at risk of forming extended or compound households, so they are included in the formation models, but not the dissolution models, because they are not in that risk set. The estimated hazard function of the break-up of extended households decreases over the study period, while the hazard of the break-up of compound households increases (Figure 5). The hazard of the formation of extended households increases over the study period, whereas the hazard of the formation of compound households decreases (Figure 6). At this time, it is speculated that the increasing prevalence of extended households and decreasing prevalence of compound households may be attributable to depopulation or changing economic conditions. Although these hazard trends are not always monotonically increasing or decreasing, time was modeled using a linear function. The linear time function had better model fit when compared to a general, or piecewise, time function, as measured by likelihood-ratio tests and the Bayesian Information Criterion (BIC), and did not significantly affect parameter estimates and z-scores.

Several models of the effect of household size on the breakdown and formation of extended and compound households were estimated with controls for the linear effects of time, as measured by census intervals, and other covariates. Household size was modeled as a time-varying covariate with no lags, such that the relevant household size for a given dissolution or formation event was that immediately prior to the event. Births and deaths that occurred in the census interval were also modeled as time-varying covariates. While the exact dates of the births and deaths are known from vital registers, it was necessary to sum them over the census interval to make them consistent with the intervals in which the outcome variable is observed. Land values and ownership status were modeled as time-varying covariates, measured at each census year, even though their values changed little over time. Consumer-producer ratios were computed for each household at each census interval using the weighting system outlined by Hammel (Table 3). This weighting system was chosen because it included earlier productive contributions of children than was proposed by Chayanov. Given historical and oral accounts of farm life, it is reasonable to believe that children in 19^{th} century Orkney began assisting on the farm, albeit in limited capacities, at young ages.

Results and Discussion

Simple households range between 39 and 49 percent of the sample. Among simple-family households, the majority consist of a married couple with or without their children. The percentage of widow or widower-headed households varies from 9 to 15 percent of all simple households (Table 4). Extended households are more likely to be extended upwards or downwards than laterally. Multiple-family (but not compound) households account for between 16% and 25% of all extended households (Table 5). The most common compound households consist of two nuclear family units (Table 6). However, few compound households contain a multiple-family component unit. One might hypothesize that compound households are a way for multiple-family households to maintain close economic ties while ensuring greater privacy in living arrangements, as was the case at South Hammer.

Simple, extended, and compound family households differ not only in their composition, but in other measures of interest as well. Compound households tend to contain more people than simple or extended households, which is expected given the presence of additional dwelling space (Table 7). Consistent with their larger size, compound households experience more vital events (births and deaths) than extended or simple households (Table 8). Compound households also have higher tax valuations, which indicates that they have access to more land than smaller households (Table 9). The three household types have similar average C/P ratios, but these ratios vary more in simple households, as predicted by Hammel [7] (Table 10). Finally, simple, extended, and compound households have different land ownership patterns, with more simple and extended families owning their own land or renting from non-laird owners than is expected ($\chi^2 = 9.76$, df = 4, $p = 0.045$, Table 11). Although most of the differences among household forms in household size, valuation, number of vital events, C/P ratio, and landowner status are small, changes in these variables may be important in predicting transitions from one household form to another. Since many of these measures change over time, a variable that is a linear combination of ten-year census periods will be included in each model.

Dissolution of Extended and Compound Households

The results of the discrete time hazard models of household dissolution are given in Tables 12 and 13. The main effects model and a model that includes the interaction of land value with household size are presented here. Models were estimated for other interactions of main effects, but only the interaction of land value and household size is reported here, because among interaction models, those that included this term had the best model fit, in terms of BIC, and the interaction term was often significant.

In the main effects models of both household types, household size and C/P ratio are significant (or nearly significant) at the $p = .05$ level. The coefficients of these terms are similar between the two household types, with household size having a small, negative effect on the risk of dissolution, and C/P ratio having a larger, positive effect. However, extended and compound households differ with respect to the effects of births and deaths on the risk of household dissolution. In extended households, deaths significantly increase the rate of dissolution, whereas births have a negative but non-significant effect. In contrast, births have a significant negative effect on the risk of dissolution of compound households, while deaths are not significant.

There are also differences between the two household types in the interaction models. When the interaction of land value and household size is considered for compound households, the effect of household size becomes non-significant, while the coefficient for land value increases and approaches significance ($p = .053$). In the case of extended households, the inclusion of the interaction term slightly changes the effect of household size, which is no longer significant, but not land value. Thus, the initial counter-intuitive finding that large households are less likely to split than smaller households does not hold when considering the interaction of household size with the amount of land available. In both models, the coefficient of C/P ratio was positive, indicating that as the number of consumers relative to producers increases, or the economic situation of the household is less favorable, the more likely a household is to break apart. This finding is interesting and worthy of further investigation. If extended and compound households are, in general, economically advantageous to nuclear households, why are households with unfavorable C/P ratios more likely to split up? It may be the case that individuals in struggling households often leave to seek work or other economic opportunities outside of the household, thereby contributing to the risk of the household returning to a nuclear form. Household size may be a mitigating factor in the process for extended households, as the addition of an interaction term for C/P ratio and household size changes the sign of the main effect of C/P ratio. However, this is not the case for compound households, for which the inclusion of this term only affects the significance level of the main effect of C/P ratio, but not its direction.

The differential effect of births and deaths on the risk of household dissolution in the two household types is another interesting finding. One might expect that the number of deaths is more likely to contribute to the dissolution of extended households, which on average are smaller than compound households. However, potential explanations for the differential effect of the number of births on the dissolution of compound households are likely to be more complex and less intuitive. For both household types, a greater number of births in a household reduces the risk of dissolution, but the term is only significant in compound households. The potential implications of this finding will be taken up below in the context of the results of the formation models.

Formation of Extended and Compound Households

The results of the discrete time hazard models of household formation are given in Tables 14 and 15. Again, both the main effects model and a model that includes the interaction of land value with household size are presented. As in the case of household dissolution, the interaction models were estimated for other interactions, but only the interaction of land value and household size is included because these models have better fit in terms of BIC. The results of the models of household formation for each household type vary more than they do for household formation, so the two types will be discussed separately.

In the main effects model of compound households, unfavorable C/P ratios reduce the risk of formation. If it is true that one step in the formation of a compound household is the addition or renovation of a dwelling structure at an existing farmstead, then it is reasonable that families that are struggling economically may not have access to the resources required to construct this defining feature of a compound household. Births significantly increase the risk that a household will become a compound household. Births in a family may signal that a household is in the growth phase of the domestic life-cycle, and families may wish to accommodate their growing numbers with additional dwelling space while maintaining the economic advantages of a larger labor pool. This finding is consistent with the negative effect of births on the dissolution of compound households. In the interaction model, the main effects of C/P ratio and births remain relatively unchanged, while the interaction of land value with household size and the main effect of land value are also significant. Households with access to more land are more likely to become compound households, although the overall effect is small.

In the main effects model of the formation of extended households, deaths in the family significantly decrease the risk of household extension. This finding is unsurprising, as the deaths of household members increase the likelihood that the potential individuals who could contribute to the categorization of that household as extended, such as grandparents or grandchildren, are no longer present. In the interaction model, the effect of deaths remains the same, while the interaction term is small, but significant, and the effect of land value is small, but approaching significance ($p = 0.069$). Thus, when the interaction of household size and land value is considered, the amount of land available to a household slightly increases the chances that the household becomes extended.

Conclusions and Future Directions

Descriptive statistics and event history models demonstrate that compound and extended households are different, both in several variables of interest and in their risks of formation and dissolution. The differential effects of births and deaths on the risks of formation and dissolution are particularly striking. The effects of deaths on extended households may be related to the fact that the categorization of a household as extended may only depend on the presence of one person. However, in compound households, the death of a single individual is less likely to affect the classification of the rest of the household as compound. The role of births, however, may indicate that a different process is at work. Compound households may be a way for growing families to adjust to increased numbers while ensuring greater privacy and living space while maintaining economic dependence and a larger labor pool. Suppose that these families are analogous to stem or joint households if it were not for the existence of separate dwellings, such as in the case of South Hammer. If this is the case, compound households may be forming and splitting in a response to younger generations beginning and ending their childbearing years. When a couple present household begins to have children, the household's need or desire for additional living space increases with the addition of new members and thereby increases the risk of transition to a compound living arrangement. Years later, when those children begin to leave home, there is a lesser need for additional dwelling space, which might contribute to the consolidation of a compound household into a non-compound extended or simple household. However, to test this hypothesis, it is important to know the kinship relationships among the component members of compound households. While the current state of data linkage does not yet allow for this, such relationships could be studied in the future.

Surprisingly, land values had small effects, often significant only in interaction models. While theoretically, access to land is an essential determinant of smallholder economics, there may not be enough variation in holdings in Orkney to discern the effects. Alternately, the use of valuation rolls as a proxy for land size may not be sensitive to other important considerations. For example, agricultural improvements, such as manuring and drainage, take labor and capital inputs and increase production, but do not affect the overall acreage available to a household. Finally, C/P ratios have strong, important effects on the risk of household dissolution and formation. However, the interpretation of these effects remains difficult. Perhaps the development of other measures of household composition could better elucidate the nature of household composition rather than roughly estimate the ratio of total consumers to total producers. The measurement of household composition remains an area for further development.

Acknowledgements

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Tables and Figures

Figure 1. Map of Orkney.

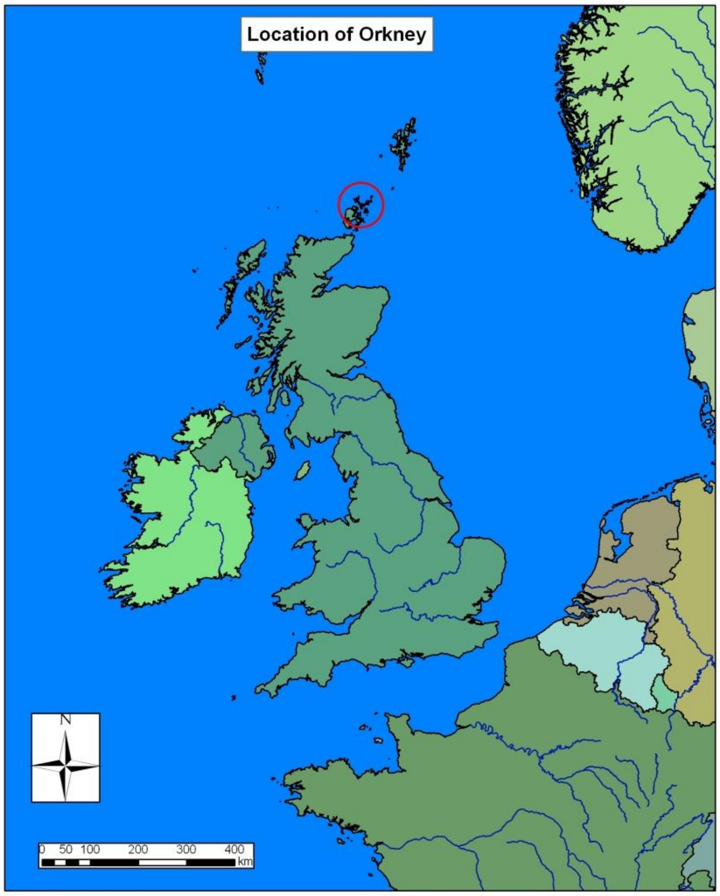

Table 1. Counts and Frequency of Household Types by Census Year.

Year	Simple	Proportion Simple	Extended	Proportion Extended	Compound	Proportion Compound	Total
1851	184	0.43	77	0.18	167	0.39	428
1861	182	0.39	89	0.19	190	0.41	461
1871	198	0.42	104	0.22	173	0.36	475
1881	195	0.39	120	0.24	179	0.36	495
1891	220	0.47	104	0.22	144	0.31	468
1901	227	0.49	116	0.25	120	0.26	463

Table 2. Inhabitants of the croft of South Hammer, Westray, 1901 (from 1901 UK national census)

Name	Relation to head	Marital status	Sex	Age (years)	Occupation
1. Stewart Patersonhead		m	♂	64	farmer
1. Mary Paterson	wife	m	♀	58	
1. Robert Paterson	son	s	♂	24	assisting on farm
2. William Paterson	head	m	♂	63	fisherman, blacksmith
2. Isabella Paterson	wife	m	♀	56	
2. Robert Paterson	son	s	♂	29	fisherman
3. Janet Rendall	head	w	♀	51	housekeeper
3. William Rendall	son	s	♂	27	ploughman at Tirlot[1]
3. John Rendall	son	s	♂	17	ploughman at Tirlot
3. Charles Rendall	son	s	♂	13	scholar[2]
3. Jessie Rendall	dau	s	♀	11	scholar

[1] The home fields of the large estate that owned South Hammer
[2] I.e. student at the local grammar school

Figure 2. Genealogical relationships of the inhabitants of South Hammer, 1901.

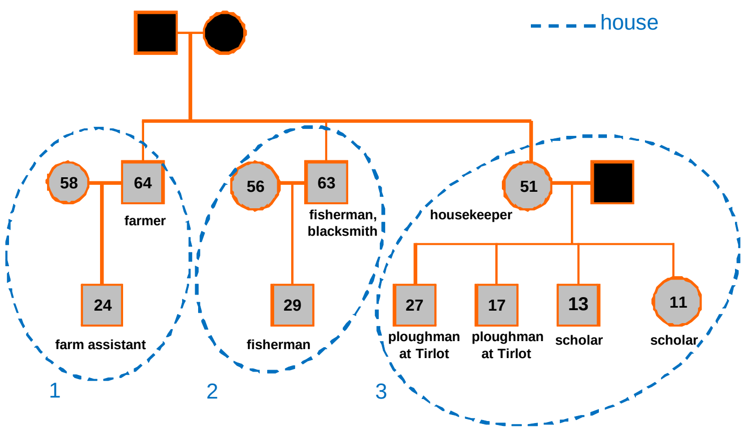

Figure 3. Plan of the surviving structures at South Hammer, 2003.

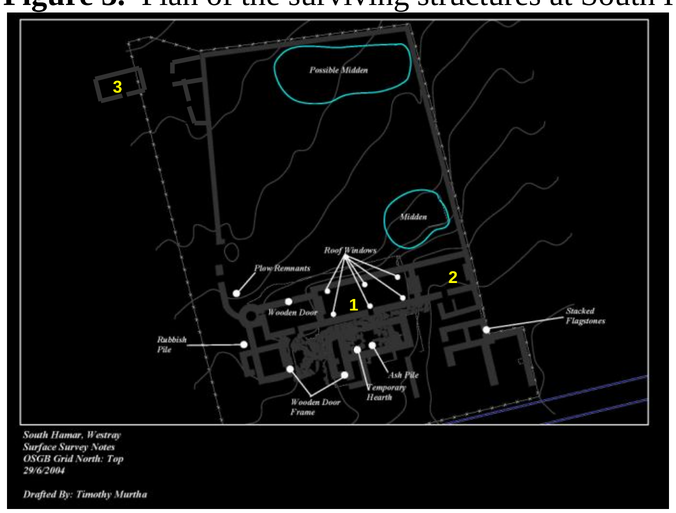

Figure 4. OSGB Map of South Hammer, showing farm and dwelling structures, 1901.

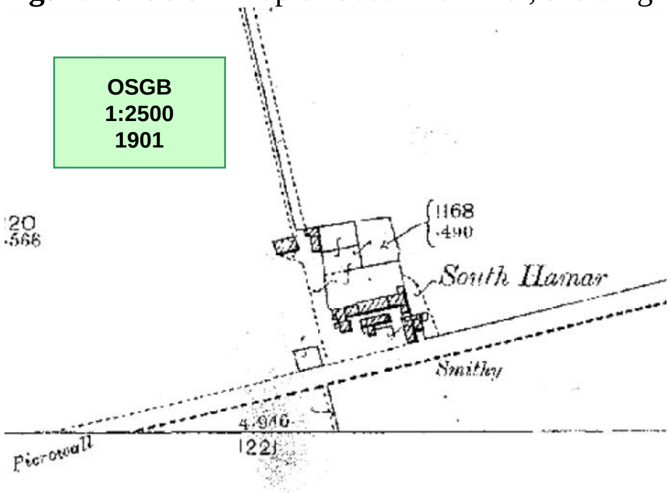

Figure 5. Hazard of Household Dissolution by Census Year.

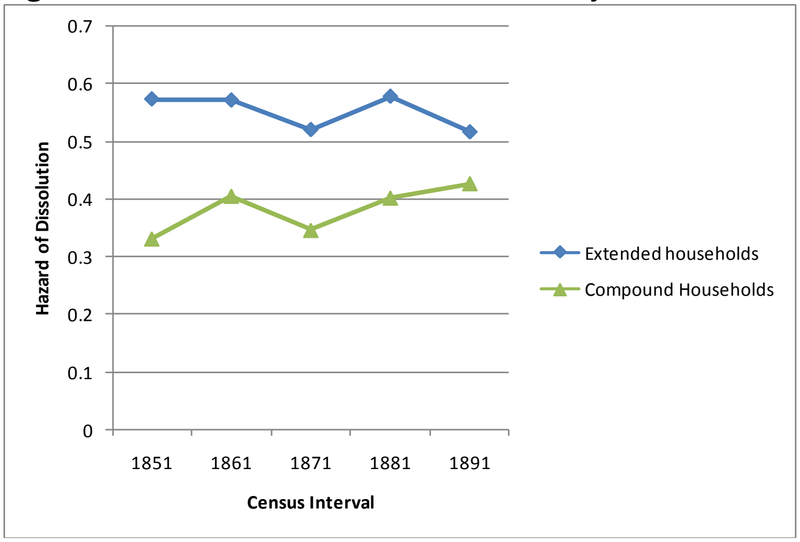

Figure 6. Hazard of Household Formation by Census Year.

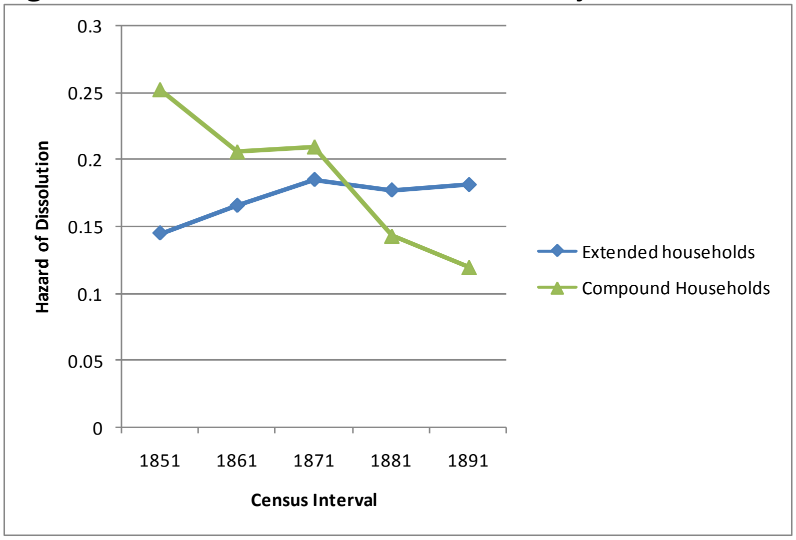

Table 3. Weighting System for Consumer-Producer Ratios, after Hammel(2005).

Production				Consumption			
Male		Female		Male		Female	
Age	Units	Age	Units	Age	Units	Age	Units
5	0	5	0	2	0.1	2	0.1
7	0.1	6	0.2	5	0.3	5	0.3
9	0.2	10	0.5	9	0.5	6	0.5
12	0.5	15	0.7	12	0.7	10	0.7
15	0.9	20	0.7	15	0.8	12	0.8
50	1.0	60	0.8	50	1.0	60	0.8
100	0.8	100	0.7	100	0.8	100	0.7

Table 4. Composition of Simple Family Households by Census Year.

HH Composition	1851	1861	1871	1881	1891	1901
No family/Solitaries	0.07	0.06	0.13	0.12	0.09	0.11
Married Head	0.82	0.83	0.77	0.76	0.79	0.74
Widower/Widow Head	0.11	0.10	0.09	0.12	0.12	0.15

Table 5. Extended Family Household by Type of Extension and Census Year.

Type of Extension	1851	1861	1871	1881	1891	1901
Up	0.27	0.33	0.25	0.35	0.29	0.32
Down	0.25	0.31	0.27	0.23	0.20	0.23
Lateral	0.15	0.13	0.15	0.17	0.14	0.08
Combination	0.11	0.07	0.15	0.06	0.14	0.13
Multiple family	0.23	0.16	0.19	0.19	0.24	0.25

Table 6. Composition of Compound Households by Census Year.

HH Composition	1851	1861	1871	1881	1891	1901
At least 1 extended unit	0.32	0.29	0.35	0.36	0.34	0.38
No extended units	0.62	0.66	0.58	0.57	0.59	0.57
At least 1 multiple unit	0.06	0.05	0.07	0.07	0.07	0.05

Table 7. Average Household Size by Type and Census Year.

Year	All	Compound	Extended	Simple
1851	7.71	11.16	6.58	5.35
1861	7.50	10.24	6.48	5.19
1871	7.35	11.13	6.34	4.72
1881	6.96	9.73	6.44	4.92
1891	6.54	9.86	6.12	4.62
1901	6.03	9.66	5.94	4.42

Table 8. Average Number of Vital Events per Census Interval by Household Type.

HH Type	Births	Deaths
Simple	0.87	0.48
Extended	1.15	0.67
Compound	1.89	0.92

Table 9. Mean Land Valuation by Household Type.

Household Type	Mean Valuation
Simple	7.92
Extended	8.65
Compound	12.46

Table 10. Average and standard deviation of consumer-producer ratios by household type.

HH Type	Mean CP	sd CP
Simple	1.091	0.122
Extended	1.097	0.090
Compound	1.102	0.086

Table 11. Number of Households by Ownership Status and Type.

Ownership Status	Number Households	Number Simple	Number Extended	Number Compound	Mean HH Size	Mean Valuation
Landowner	60	32	8	19	6.78	11.41
Laird's Tenant	1,954	797	459	698	7.07	9.47
Other Tenant	48	17	7	24	7.52	17.69

Table 12. Estimates of covariate effects on the dissolution of extended households, discrete time logit hazard model, northern Orkney, 1851-1901.*

	Main Effects Model	Interaction Model	Coef.	Std. Err	Odds Ratio	p-value
	Household size		-0.108448	0.0597745	0.8972254	0.07
	Land Value		0.0303814	0.0154076	1.0308476	0.049
	C-P ratio		2.512237	1.369301	12.332487	0.067
	Landowner (1=yes, 0=no)		1.012665	0.6909074	2.7529278	0.143
	Number of Births		-0.092985	0.0722037	0.9112071	0.198
	Number of Deaths		0.35988	0.12039	1.4331574	0.003
	Time		-0.105329	0.0876595	0.9000283	0.23
	Constant		-2.025152	1.413334	0.1319738	0.152
		Household size	-0.098106	0.0779358	0.9065529	0.208
		Land Value	0.0380249	0.0503178	1.0387571	0.45
		C-P ratio	2.505078	1.368229	12.244514	0.067
		Landowner (1=yes, 0=no)	1.028163	0.702708	2.795925	0.143
		Number of Births	-0.093225	0.0722066	0.9109888	0.197
		Number of Deaths	0.3579332	0.1204831	1.4303701	0.003
		Land Value X HH Size	-0.000971	0.0055984	0.9990292	0.862
		Time	-0.105445	0.0876377	0.8999242	0.229
		Constant	-2.087927	1.453856	0.1239438	0.151
Log-likelihood	-243.4416	-243.4239				
BIC	534.0824	539.9469				
N	207	207				

Table 13. Estimates of covariate effects on the dissolution of compound households, discrete time logit hazard model, northern Orkney, 1851-1901.*

	Main Effects Model	Interaction Model	Coef.	Std. Err	Odds Ratio	p-value
	Household size		-0.1038249	0.0287685	0.9013831	<.001
	Land Value		-0.005869	0.0089564	0.9941482	0.512
	C-P ratio		3.948718	1.13672	51.868828	0.001
	Landowner (1=yes, 0=no)		0.9167287	0.6110254	2.5010952	0.134
	Number of Births		-0.1779355	0.0458429	0.8369964	<.001
	Number of Deaths		-0.0258236	0.0774758	0.974507	0.739
	Time		0.0632275	0.0637964	1.0652692	0.322
	Constant		-3.615853	1.194946	0.026894	0.002
		Household size	-0.0446018	0.0371888	0.9563782	0.23
		Land Value	0.0512725	0.0264648	1.0526097	0.053
		C-P ratio	3.730891	1.12159	41.716261	0.001
		Landowner (1=yes, 0=no)	1.05322	0.656457	2.8668676	0.109
		Number of Births	-0.1852419	0.0463635	0.8309033	<.001
		Number of Deaths	-0.0245274	0.0781382	0.975771	0.754
		Land Value X HH Size	-0.0052979	0.0023151	0.9947161	0.022
		Time	0.0636414	0.0633894	1.0657102	0.315
		Constant	-3.95117	1.189352	0.0192322	0.001
Log-likelihood	-389.4677	-386.1149				
BIC	830.5518	830.2982				
N	277	277				

Table 14. Estimates of covariate effects on the formation of extended households, discrete time logit hazard model, northern Orkney, 1851-1901.*

	Main Effects Model	Interaction Model	Coef.	Std. Err	Odds Ratio	p-value
	Household size		-0.0262503	0.0206204	0.9740912	0.203
	Land Value		-0.0047377	0.0081093	0.9952735	0.559
	C-P ratio		-0.8581887	0.7258235	0.4239293	0.237
	Landowner (1=yes, 0=no)		-0.3324438	0.4493561	0.717169	0.459
	Number of Births		0.013152	0.0364318	1.0132389	0.718
	Number of Deaths		-0.1509583	0.0744372	0.8598836	0.043
	Time		0.0257599	0.0543969	1.0260946	0.636
	Constant		-0.2866457	0.8123304	0.7507777	0.724
		Household size	0.0109617	0.0240546	1.011022	0.649
		Land Value	0.0284126	0.015647	1.0288201	0.069
		C-P ratio	-0.9798035	0.7330141	0.3753849	0.181
		Landowner (1=yes, 0=no)	-0.3018693	0.4507452	0.7394347	0.503
		Number of Births	0.0102423	0.036773	1.0102949	0.781
		Number of Deaths	-0.1557215	0.0750866	0.8557975	0.038
		Land Value X HH Size	-0.0035417	0.0013868	0.9964646	0.011
		Time	0.0254718	0.0542277	1.025799	0.639
		Constant	-0.4412077	0.8217653	0.6432591	0.591
Log-likelihood	-598.6923	-596.2344				
BIC	1254.546	1256.776				
N	420	420				

Table 15. Estimates of covariate effects on the formation of compound households, discrete time logit hazard model, northern Orkney, 1851-1901.*

	Main Effects Model	Interaction Model	Coef.	Std. Err	Odds Ratio	p-value
	Household size		0.0184799	0.0509043	1.01865171	0.717
	Land Value		0.0134858	0.0122166	1.01357714	0.27
	C-P ratio		-2.553668	1.123173	0.07779579	0.023
	Landowner (1=yes, 0=no)		-0.140536	0.4894046	0.86889238	0.774
	Number of Births		0.2203059	0.0470344	1.24645796	<.001
	Number of Deaths		0.0368289	0.0951054	1.03751549	0.699
	Time		-0.3063733	0.0599686	0.73611178	<.001
	Constant		1.65979	1.104036	5.25820651	0.133
		Household size	0.1048126	0.0637833	1.11050248	0.1
		Land Value	0.0688175	0.0208259	1.07124069	0.001
		C-P ratio	-2.794664	1.149357	0.06113541	0.015
		Landowner (1=yes, 0=no)	-0.0795702	0.5038712	0.92351319	0.875
		Number of Births	0.2204714	0.0469534	1.24666427	<.001
		Number of Deaths	0.0231879	0.0954426	1.02345883	0.808
		Land Value X HH Size	-0.0078576	0.0032361	0.99217319	0.015
		Time	-0.3076187	0.0606506	0.73519559	<.001
		Constant	1.401847	1.128848	4.06269684	0.214
Log-likelihood	-447.8048	-444.2443				
BIC	950.8636	950.6494				
N	362	362				

*Standard errors adjusted for multiple observations by clustering over household identifiers

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