

Chapter 7

Discussion: Historical human-environment interactions in the southern Faroe Islands

Introduction

Chapters 7 and 8 discuss the significance of the collected data presented in chapter 6. The discussion in chapter 7 assesses the extent to which people have impacted the Faroese environment (or not) according to the results of the site-specific, hypothesis-led research conducted on Suðuroy and Sandoy. The discussion in chapter 8 examines the circumstances whereby people put unsustainable demands on island environments more generally, by integrating original and secondary research from Iceland and Greenland.

Chapter 7 is composed of four parts. Part one outlines the structure of the chapter in more detail and parts two and three discuss the pre-colonisation/*landnám* and post-colonisation/*landnám* landscape of the Faroes respectively, from which assumptions regarding the significance of the human impact in the southern Faroes can be drawn. To conclude, part four examines the causes behind the specific outcomes of human impact in the Faroe Islands.

7.1 Historical human-environment interactions in the southern Faroe Islands

In order to begin to understand the impact made by settlers on the localised Faroese environment, and whether or not that impact was sustainable over millennial timescales, the form and processes operating in the environment prior to the arrival of people (i.e. from the mid-late Holocene to colonisation) need to be assessed. Understanding longer-term trajectories of landscape change and their direction in relation to potential thresholds of change, and how sensitive or robust, dynamic or stable, the natural environment is, helps to separate anthropogenic impacts from natural environmental changes in the post-colonisation landscape record. Secondly, the timing of the arrival of people needs to be identified, along with the extent to which initial settlement had an impact on the natural landscape, as early impacts may affect the way in which consequent impacts develop. Thirdly, to understand the demands people make on the environment, the diversity of these activities and their impact requires analyses over longer timescales, which can be compared and contrasted with the outcomes of initial impact. On the one hand, early impacts may be significant as settlers experiment with an unfamiliar environment, but diminish as people adapt to the conditions over the long-term. On the other hand, environmental degradation may increase with little

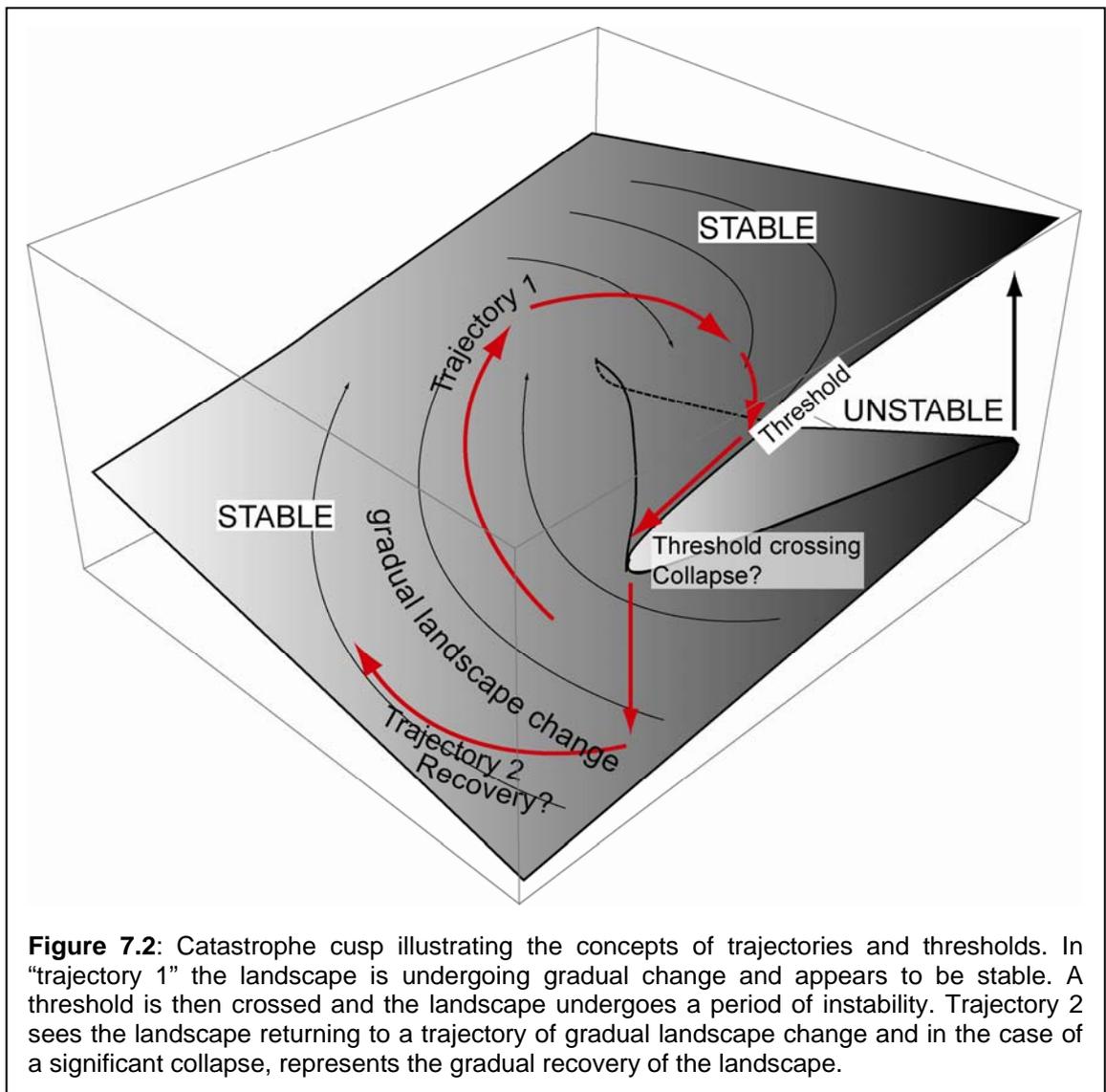
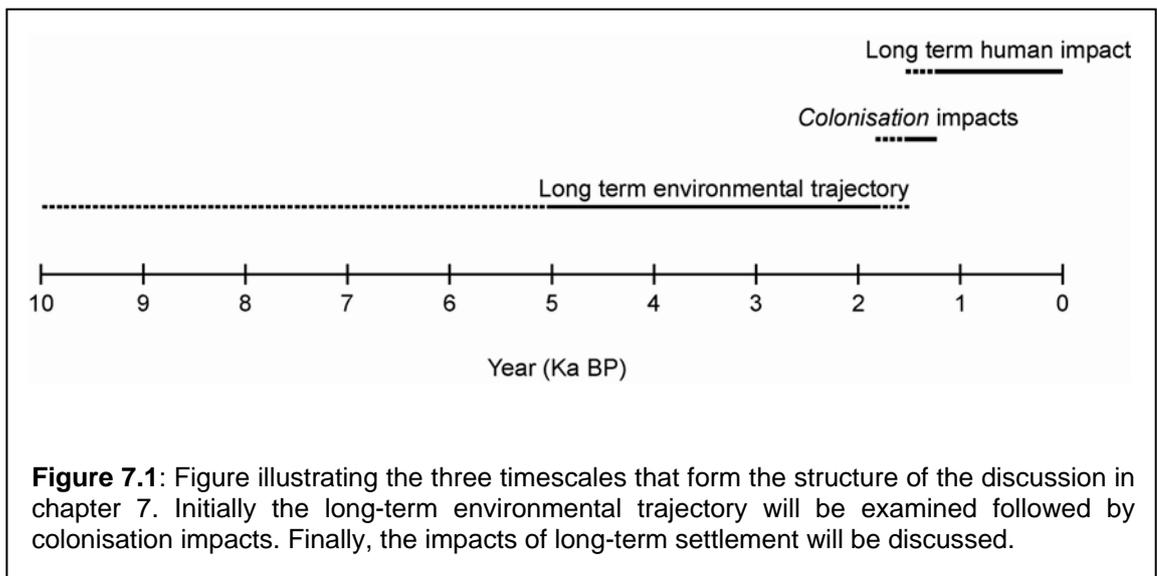
evidence of adaptation, either from the influence of natural factors such as climatic deterioration, or through cultural factors, such as ineffective human decision making (refer to hypothesis 5 in Table 1.1). An illustration of the timescales over which the thesis discussion will take place is presented in Figure 7.1. Although collected data is specific to the Faroe Islands, these issues relate to wider questions of island colonisation, and whether major environmental thresholds are crossed prior to the arrival of people, with the arrival of people, or over long-term settlement. The extent to which outcomes were constrained and the extent to which other scenarios were likely or possible are key issues for both the Faroes and other North Atlantic islands.

7.2 The pre-*landnám* landscape of the southern Faroe Islands

Long-term trajectories and thresholds: soil stratigraphic and landform evidence

In order to understand the degree to which the Faroese environment was impacted by people and contemporary natural perturbations, the longer-term trajectories of the Faroese environment and the processes operating are addressed. The longer-term trajectory is dependent on the degree to which the landscape is sensitive or resilient, in other words why, when, where, how often and how quickly landscapes undergo change (sensitivity) and how easily those landscapes recover following external perturbations (resilience). Sensitivity and resilience are related to the concept of thresholds, which in this context refers to a point whereby the environment changes from one phase or trajectory to another (Schumm 1979, Phillips 2003). Geomorphic thresholds result from intrinsic or extrinsic factors, but at the landscape scale considered here, most threshold crossing events are caused by external variables, by climatic change or anthropogenic impact.

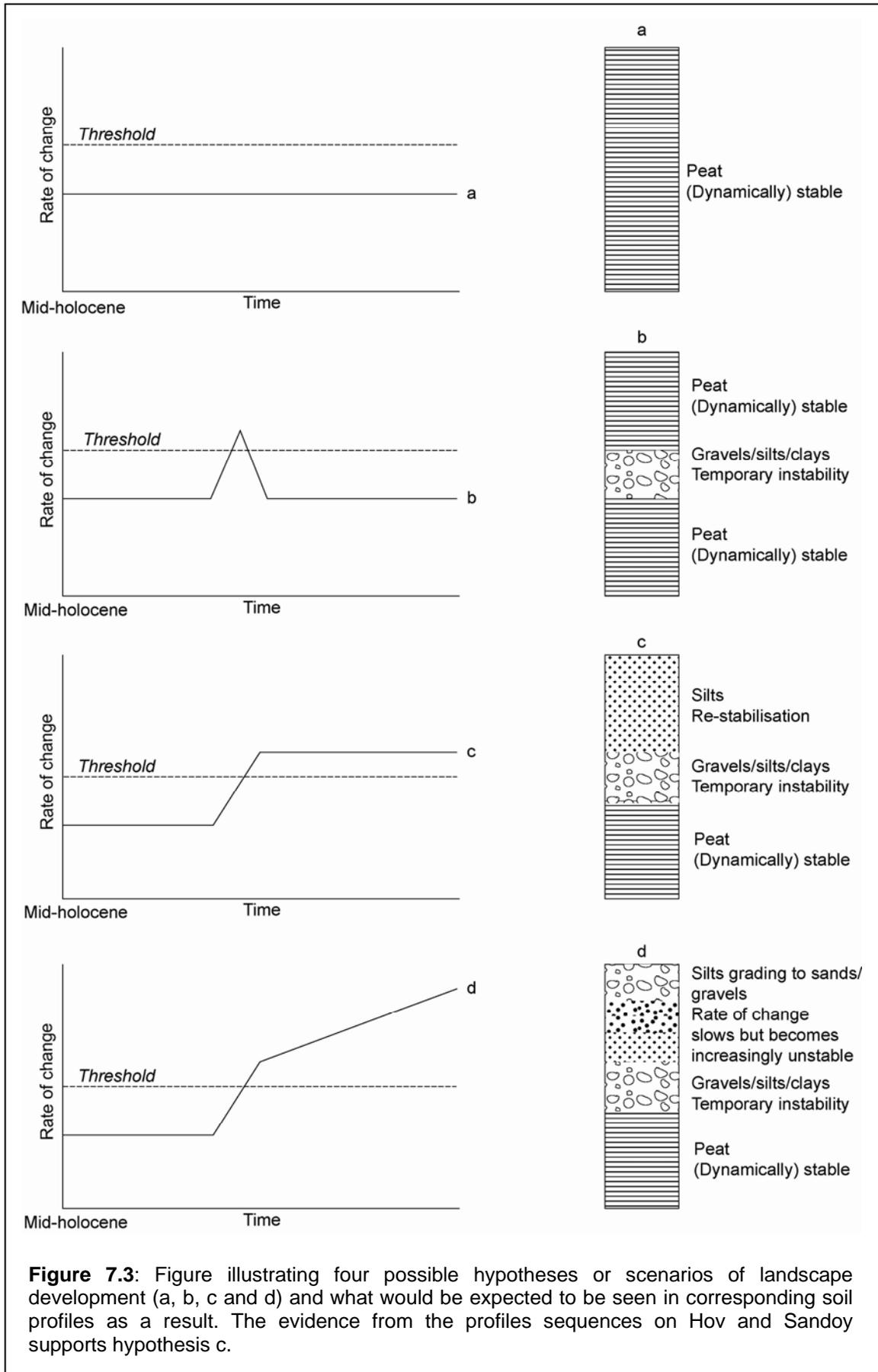
After a threshold has been crossed, the longer-term trajectory may return to its pre-perturbation level or is irreversibly altered to a new trajectory. This is dependent on the response and resilience of the landscape. Environmentally marginal landscapes such as those with nutrient poor, shallow or easily eroded soils, or landscapes with limited environmental or ecological buffers, which are more susceptible to change, may be irrevocably altered and pursue a new environmental trajectory. More environmentally resilient landscapes may recover from external perturbations and return to the pre-perturbation trajectory. The degree of landscape recovery is also dependent on the length of the perturbation. For example, extreme events, such as floods or *jökulhlaups*, occur over a relatively short period, and although devastating, the local environment can resume its recovery soon after. Persistent anthropogenic impact may, however, continue to affect the environment for decades or centuries, hindering landscape recovery. People also influence the extent of environmental resilience and recovery. For example, anthropogenic soil erosion



reduces the ability of the environment to recover from an unrelated external perturbation, such as a hazard event.

The notion of a catastrophe cusp, although originating from mathematics, is applicable to illustrating ideas of landscape deterioration and recovery (Figure 7.2). Following a trajectory along the catastrophe cusp, the landscape can be changing and adapting gradually to anthropogenic change but appearing outwardly stable. Although a landscape may have been undergoing a process of gradual deterioration, in what in isolation may be a small external (or internal) trigger, can cause a massive environmental deterioration (a threshold crossing event), leaving the system in an unstable state. Stability is then regained through a process of landscape recovery. The catastrophe cusp can also be applied to biological changes on islands, firstly to the extinction of species, and secondly, to the introduction of species, which represents a threshold that under some circumstances is difficult to reverse.

Thresholds can be identified in the late Holocene Faroese landscape by examining changes in sediment profiles and surface landforms. The form of a particular landscape will reflect different geomorphic processes (both high-magnitude, low frequency and high frequency, low magnitude), the historical trajectory of environmental drivers of those processes (dominantly climate and vegetation and tectonics) and any specific contingencies (such as extreme events and human activity) (Bracken and Wainwright 2006). Stratigraphic sequences are effectively a preserved account of how landscape processes have varied through time, although records can be intermittent and only exist in areas where there has been sediment deposition. Threshold crossing events or geomorphic perturbations are manifested by distinct changes in the sediment record (where these records are available), and by the existence of specific landforms that demonstrate that the landscape has undergone a significant change from one phase to another. For example, incidences of erosion, such as slope wash, are demonstrated by gravel units in the profile, while silt influxes imply increasing aeolian erosion. Gravel and highly minerogenic units are deposited over a shorter time period than the accumulation of peat, which conversely represents a period of relative landscape stability. Changes in soil stratigraphy can be linked to a breaching of the vegetation cover, climatic changes, e.g. increased rainfall, autogenic changes, e.g. increased leaching, and human activity, e.g. grazing and compaction. Figure 7.3 illustrates the hypothetical units of the stratigraphic profile according to four trajectories of landscape development. In the Faroes, a homogenous peat unit is the outcome of a constant rate of change from the mid-Holocene with no significant external perturbations or threshold crossing events (a). If a perturbation is introduced and the landscape undergoes a threshold crossing event followed by recovery, a short lived influx of silts/sands/gravels or clay will be illustrated by the stratigraphic profile, followed by the re-establishment of peat (b). In trajectory c, the stratigraphic profile illustrates an influx of gravels/silts representing a



threshold crossing event, followed by a homogenous silt unit, representative of landscape re-stabilisation at a new rate of change. In trajectory d, the landscape continues to deteriorate after a threshold crossing event, represented in the soil profile by the influx of increasingly coarse sands, silts and gravels.

Surface geomorphological features and the boundaries between certain landforms or land units also illustrate natural mechanisms of landscape change and periods of landscape destabilisation. Gullying, cryoturbation, solifluction, peat formation and alluvial fan development have been active processes over the Holocene and represent the landscape response to changing climate, extreme weather events, ecological changes and also anthropogenic impact. These processes can be analysed through the mapping of landforms such as gullies, active and inactive fans, high and low altitude peat deposits, scree slopes and active, semi-active or inactive cryoturbation surfaces. Analyses of these different geomorphic data, in terms of how, when and where they developed, allows the historical environmental trajectory, and the form of the landscape at the time of settlement, to be determined. For example, relic periglacial surfaces at altitudes lower than affected by current periglaciation, indicate periods of colder climate in the past, and/or the removal of an inhibiting factor such as vegetation. Periglaciation in the Faroe Islands has been discussed by Humlum and Christiansen (1998a; 1998b), who record that during cold intervals of the Little Ice Age, the lower limit for periglacial activity may have temporarily approached sea level with permafrost sporadically established in the Faroese highlands.

Hypotheses regarding the timings and causes of thresholds

The initial mapping of landforms and recording of stratigraphic profiles in Hov and Sandoy was followed by assessing a second stage of hypotheses, which determined a radiocarbon dating protocol for landscape change. Figure 7.4 depicts three conceptual models that illustrate the idea of trajectories and thresholds, from which a dating protocol was developed. Figure 7.4a illustrates a generalised trajectory of the Icelandic landscape system, which was in a state of dynamic equilibrium in the late Holocene, prior to the arrival of people. In general, across Iceland, the impact of colonisation causes a threshold crossing event in the 9th century. The inherent sensitivity of the Icelandic environment, for example, the limited biota and friable volcanic soils, as well as continuing human impact, volcanic eruptions and climatic changes, e.g. the Little Ice Age, prevented landscape recovery to a pre-colonisation trajectory. The switch from a pre-colonisation to post-colonisation environmental trajectory is illustrated by stratigraphic evidence detailing the pattern of soil erosion and accumulation in Iceland. Following settlement, the sediment accumulation rate increases, often by one order of magnitude, and sometimes by several orders of magnitude (Dugmore *et al* 2000).

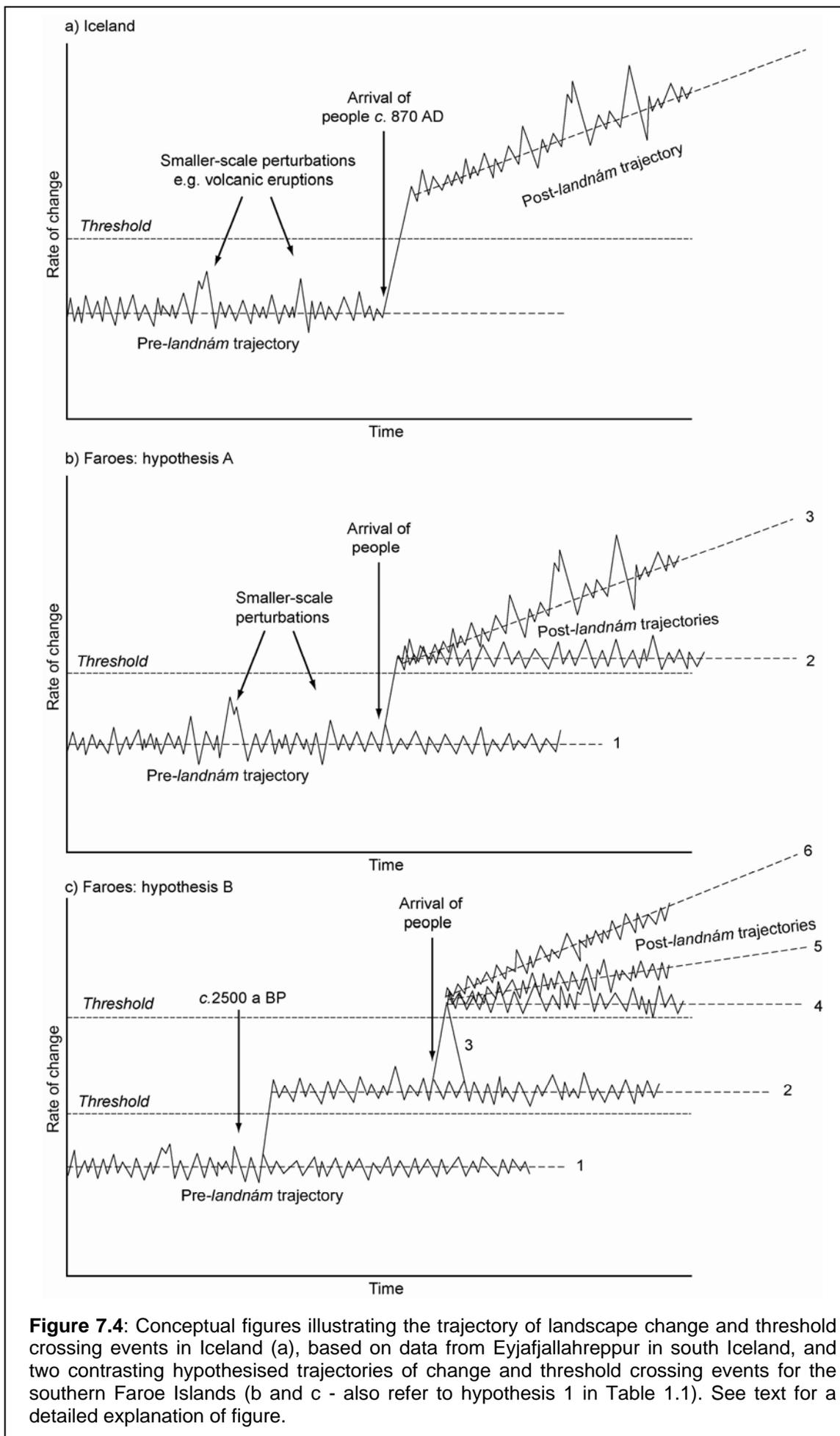


Figure 7.4: Conceptual figures illustrating the trajectory of landscape change and threshold crossing events in Iceland (a), based on data from Eyjafjallahreppur in south Iceland, and two contrasting hypothesised trajectories of change and threshold crossing events for the southern Faroe Islands (b and c - also refer to hypothesis 1 in Table 1.1). See text for a detailed explanation of figure.

Based on observations of sediment stratigraphies and landform evidence from fieldwork on Suðuroy and Sandoy, two hypotheses were proposed to explain the generalised trajectory of late Holocene landscape change (refer to hypothesis 1 in Table 1.1). The first hypothesis, illustrated by Figure 7.4b resembles, and is based on, the Icelandic model, **whereby the major landscape threshold in the Icelandic Holocene environment was crossed at the time of settlement**. This could be represented in the Faroese sediment stratigraphy, by the contact between the organic peat context and influx of gravels and silts, implying erosion. After a threshold is crossed, the environment may continue on a new trajectory at a similar rate of change to that of the pre-colonisation environment (2), or embark on a new course of trajectory at a more rapid change than previously (3). Alternatively, the enhanced aeolian sediment dispersal represented by the top silt may be related to post-colonisation climatic change and the onset of cooler and/or stormier conditions (Meeker and Mayewski 2002, Dugmore *et al* 2007a). This hypothesis agrees with evidence that is available for other islands colonised relatively recently, such as Iceland, which experienced significant environmental changes after colonisation.

Hypothesis B offers an alternative trajectory, **whereby a significant threshold was crossed some time prior to colonisation and hence major landscape change was initiated by an external perturbation not related to people**. This hypothesis is supported by initial observations of landforms such as the Hov box gullies (refer to Figures 6.3a and 6.3b), which had probably already developed and stabilised some time prior to the arrival of people. If a perturbation prior to colonisation caused a switch from one trajectory to another, the scale of consequent human impact needs to be understood. A scenario whereby people have no significant impact is illustrated by trajectory 2 (Figure 7.4c). Alternatively, people may have had a discernable impact on the landscape, but the environment was quick to recover (i.e. was resilient) and continued on its prior trajectory of change (3). This hypothesis proposes that the impact of people was negligible in the long term, although limited impact can be identified in contemporary landscape evidence. In scenario 4, a threshold crossing event occurs, but the landscape consequently stabilises. Trajectories 5 and 6 suggest that the environment follows a new trajectory at a more rapid rate of change than previously. The latter trajectories would be unsustainable over mid- to long-term scales. The resolution of these hypotheses, in relation to the evaluation and dating of the stratigraphic profiles and supporting evidence, is discussed below.

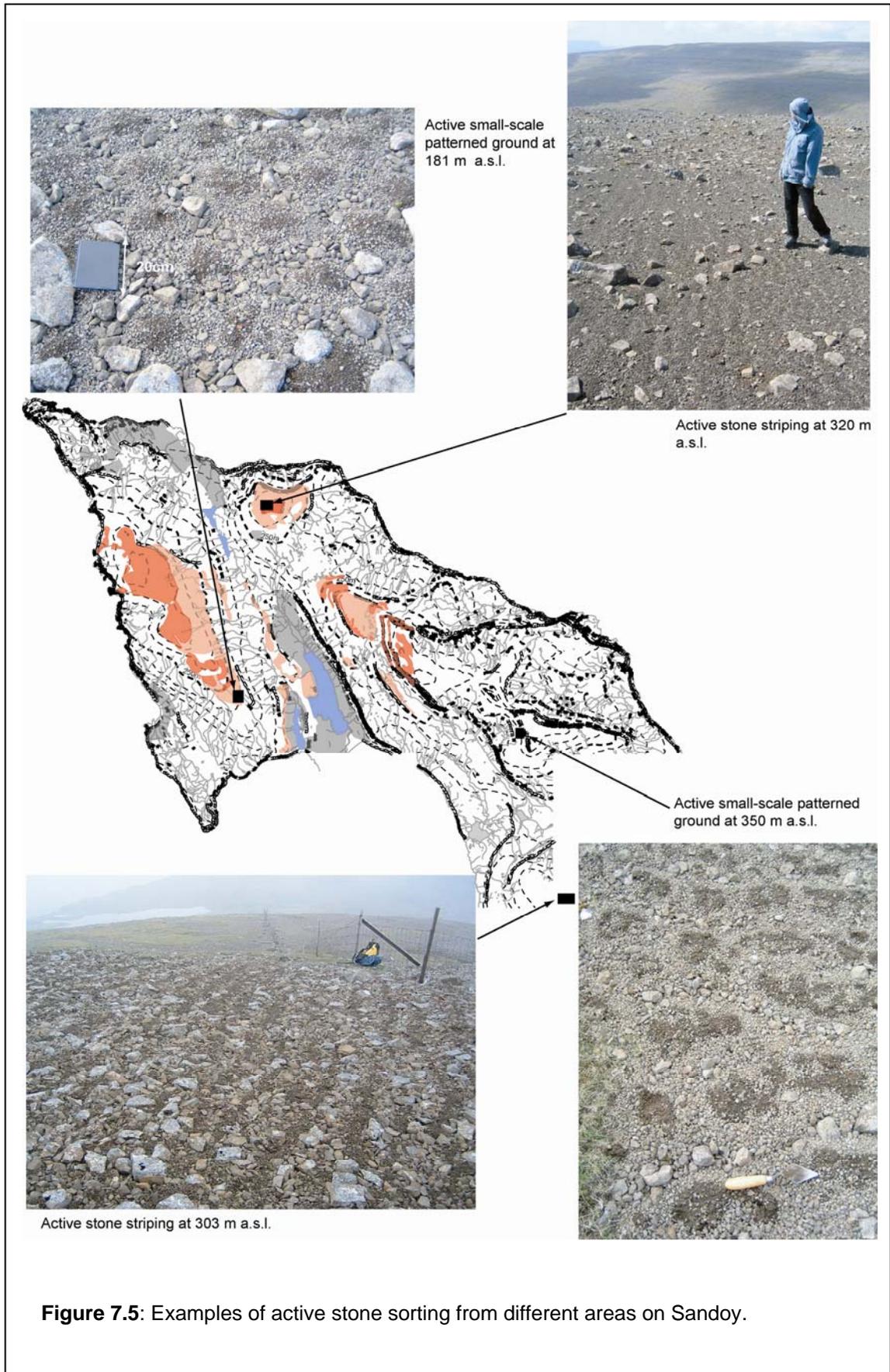
Environmental thresholds in late Holocene Faroes

Evidence of environmental thresholds in surface landforms

The following approaches were used to assess geomorphic events and change; analyses of relict forms, changes in activity within landforms, and shifting boundaries. Geomorphic and landscape analyses and mapping indicate that some landforms are essentially relict and have formed during a more dynamic or unstable geomorphic regime. This suggests past episodes of change and threshold crossing events. For example, the slopes above the village of Hov are dominated by conspicuous box gully features, now stable, which formed under a different geomorphologic regime from today. The extensive scale and extent of the gullies are such that they could not have formed within the infield areas of Faroese settlements, without compromising both occupation sites and the viability of settlement in the area. The steep headwalls of the gullies imply that the geomorphic phase in which the gullies were formed was limited in its temporal extent, which prevented further development of the gullies. The implication is that the gullies formed pre-colonisation, a hypothesis consistent with lithostratigraphic evidence (refer to Figure 6.3b). The capping of the gully systems and slopes by the top silt unit, shows that the gullies pre-date the influx of top silt. At present, the gullies, although with slopes as steep as 70°, have stabilised, are well vegetated and do not contain significant (or any) channels. This indicates that they have experienced little modification since their formation. The gullies could have been formed by a peat slip or debris flow, whereby long periods of rain, short intense storms, or snow accumulation and melt, caused the surface peat context to liquefy into a flow. There are examples of such slips occurring in peat dominated regions/islands, including the Shetland Isles, mainland Scotland, Ireland and the Falkland Islands. The existence of the Hov gullies implies that recent geomorphological change is more limited than that occurring in the pre-“top silt” period (pre-colonisation). The simplest explanation is that the gullies formed during the period of significant geomorphological activity demonstrated by the silt/gravel influx in the stratigraphic profiles. The Faroese environment displays signs of instability, supporting the existence of a threshold crossing event at this time.

Relic cryoturbation features at lower elevations than currently active indicate a colder climate. Cryoturbation features are present in Hov, on the plateau area of the south facing slopes above Hov village, and at a lower altitude further up-valley in Hovsdalur. On Sandoy, stone stripes were common on un-vegetated high altitude plateaux above c.320 m, e.g. at Knúker (c.320 m) and Eiriksfall (c.350 m) in north Sandoy and at Bøllufjall (c.300 m) and Tindur (c.350 m) in central Sandoy (Figure 7.5). To the south east of Bøllufjall, stone sorting was observed at c.180 m and therefore measurements are not altogether consistent with the present periglacial boundary of 250-450 m proposed by Humlum and Christiansen (1998a; 1998b) (Figure 7.6).

Scree slopes and talus aprons are found on slopes across both islands, but rock faces show few signs of recent block detachment or movement of talus down slope, and profiles



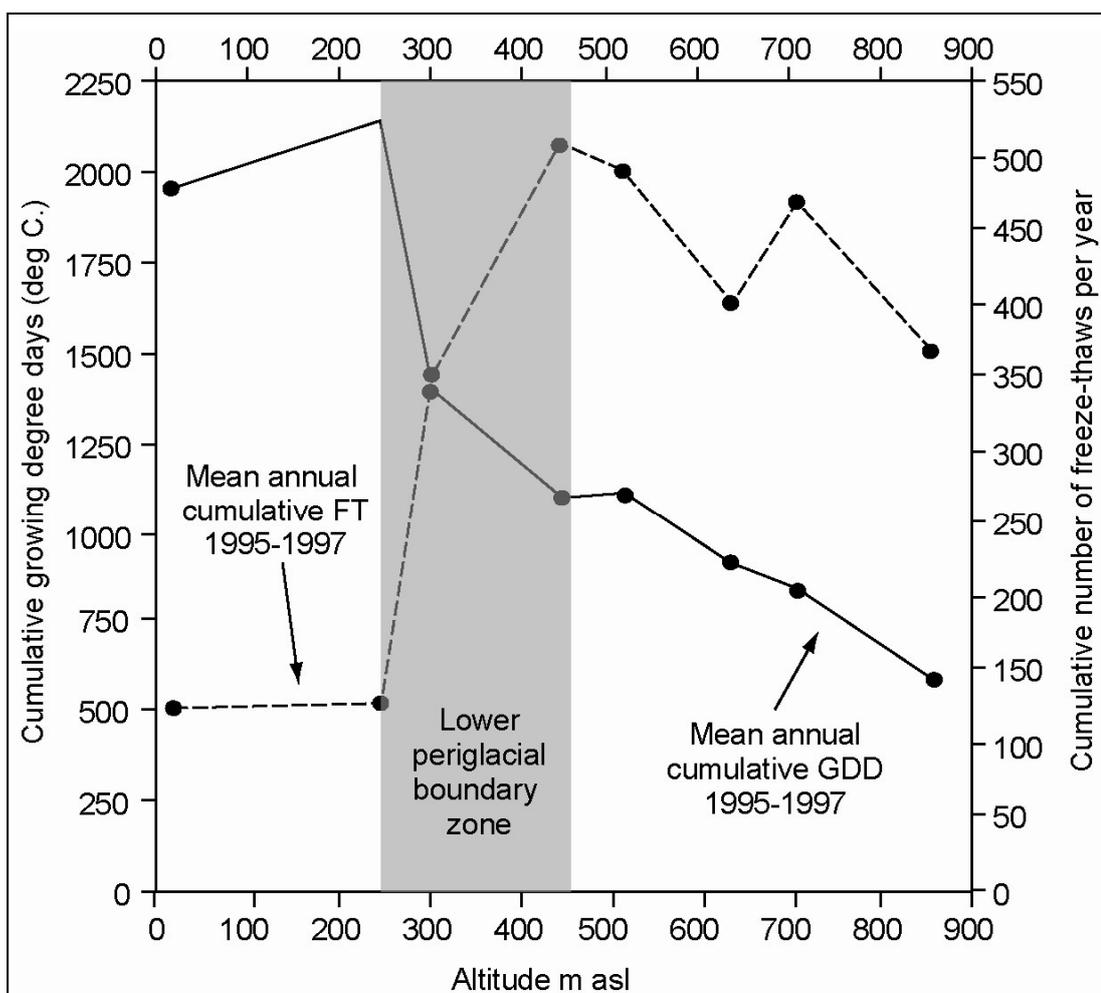


Figure 7.6: Altitudinal distribution of the mean annual cumulative number of growing degree days (GDD, left scale) and the mean annual cumulative number of freeze-thaws (FT, right scale) May 1995-1997 in the Slættaratindur massif, northern Eysturoy. The lower periglacial boundary is marked by grey shading. After Humlum and Christiansen 1998a; 1998b).

immediately down slope from the edges of talus aprons show no indication of recent scree expansion. This suggests stability over the settlement period.

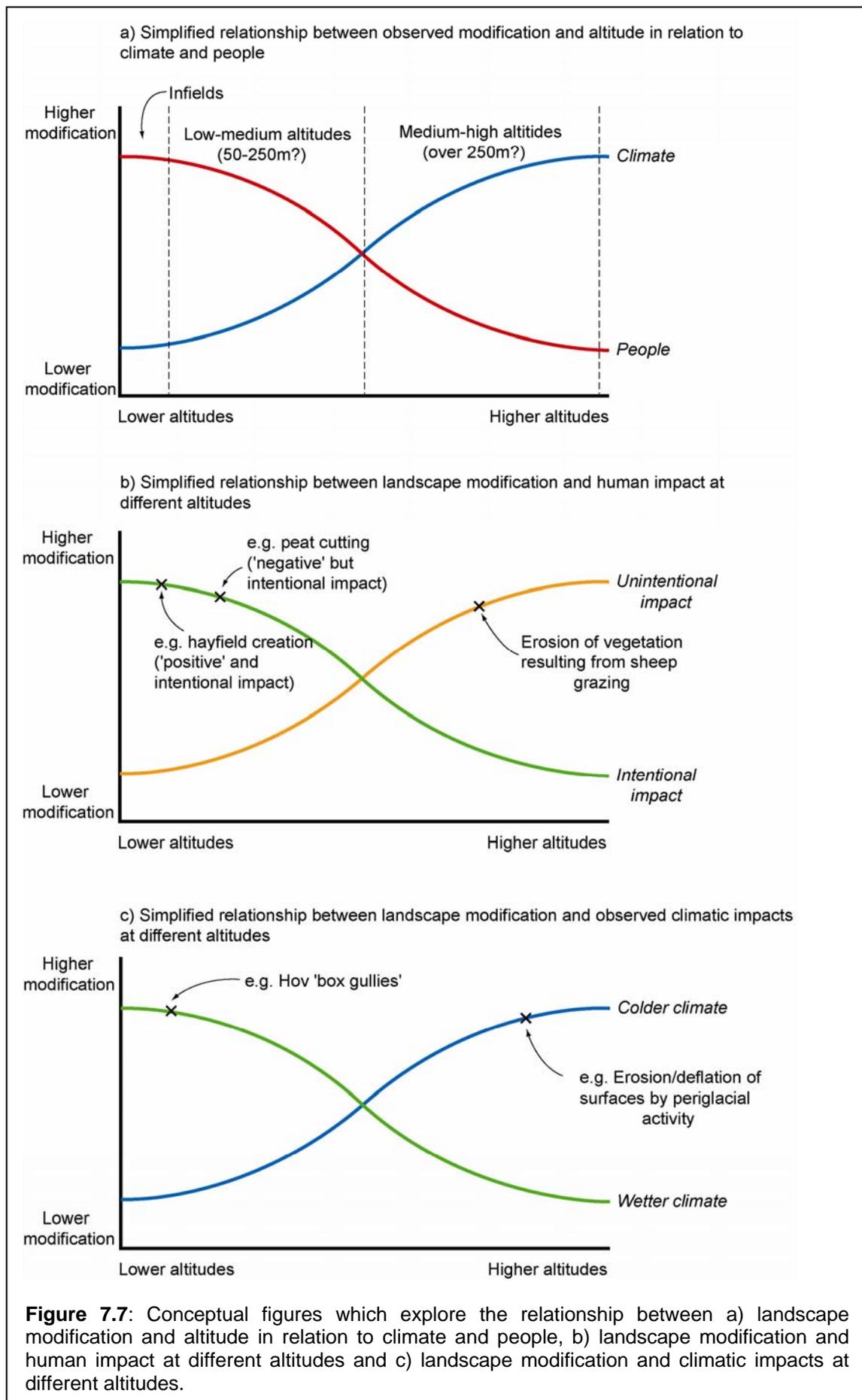
Stream and river channels and margins display comparatively limited evidence of contemporary aggradation. Channel systems in Sandoy are characterised by their absence of aggrading sediment and by stable river terraces and stable meandering channels. The implication is that limited sedimentary material has been liberated from the slopes, which suggests relatively limited erosion over the settlement period.

The limited recent influx of sediment into fluvial systems, the pre-settlement formation of major gullies and the comparative stability of fan surfaces and scree extent suggest that many key landscape boundaries in the surface geomorphological landscape were probably defined prior to colonisation, implying that geomorphological impacts directly attributable to human activity and Little Ice Age changes are restricted.

Thresholds and spatial factors in relation to surface cover

Spatial factors, in relation to the causes and timing of the threshold phases as discussed above, and in relation to the patterns of land degradation highlighted by the maps depicting the extent of vegetation cover, can also be considered. Climate, weather and human impacts will be represented to differing degrees at contradictory locations in the Faroese landscape, because different altitudes and locations are more or less sensitive to modification by people or climate (Figure 7.7). Landscapes at high altitudes and with steeper slopes are more sensitive to both climate and human impact and, therefore, more sensitive to threshold crossing events than slopes at lower altitudes where the vegetation cover is more robust and less easy to breach. Human impact will be most influential within an infield landscape, village or on gentle slopes at low to moderate altitudes. Climate and weather impacts will be dominant on steep slopes, gullies, cliff faces and at high altitudes where geomorphic activity is greater, with or without the influence of people, due to exposure, slope angles and temperature.

With regards to the spatial extent of vegetation/sediment cover, degradation of higher altitude hilltops would be expected as a result of their relative altitude and exposure. This is evident on the map depicting extent of land cover on northern Sandoy (refer to Figure 6.9). However, there are other spatial patterns highlighted by the map which do not conform to a simple altitude/exposure model, and in this case other factors that influence the spatial patterns of degradation need to be considered. Affects of altitude and aspect may also change the circumstances under which threshold crossing events occur across the landscape. Aspect, which influences the number and intensity of sunlight hours and wind



direction, might also have an affect on the sensitivity of a landscape to changes and the timing and intensity of thresholds. North facing slopes receive less sunlight rendering vegetation on north facing slopes more sensitive to climatic perturbations and resulting in greater freeze-thaw activity. Slope gradient may also influence the sensitivity of a slope to anthropogenic and natural changes. General observations from Sandoy and Hov suggest that slopes with a moderate to steep gradient are better vegetated than slopes of a slighter gradient. Moderate to steep slopes also tend to be favoured for crop growing such as barley (aside from the village of Sandur, where soils are more sandy and free draining) as a result of their better drainage. Gentle slopes with poor drainage are more subject to water logging which can lead to a breach in vegetation cover and increased susceptibility to erosion. Slope gradient may also influence the relative impact from wind on the vegetation surface. A level plateau location will be more subject to wind erosion than a valley slope that is more sheltered.

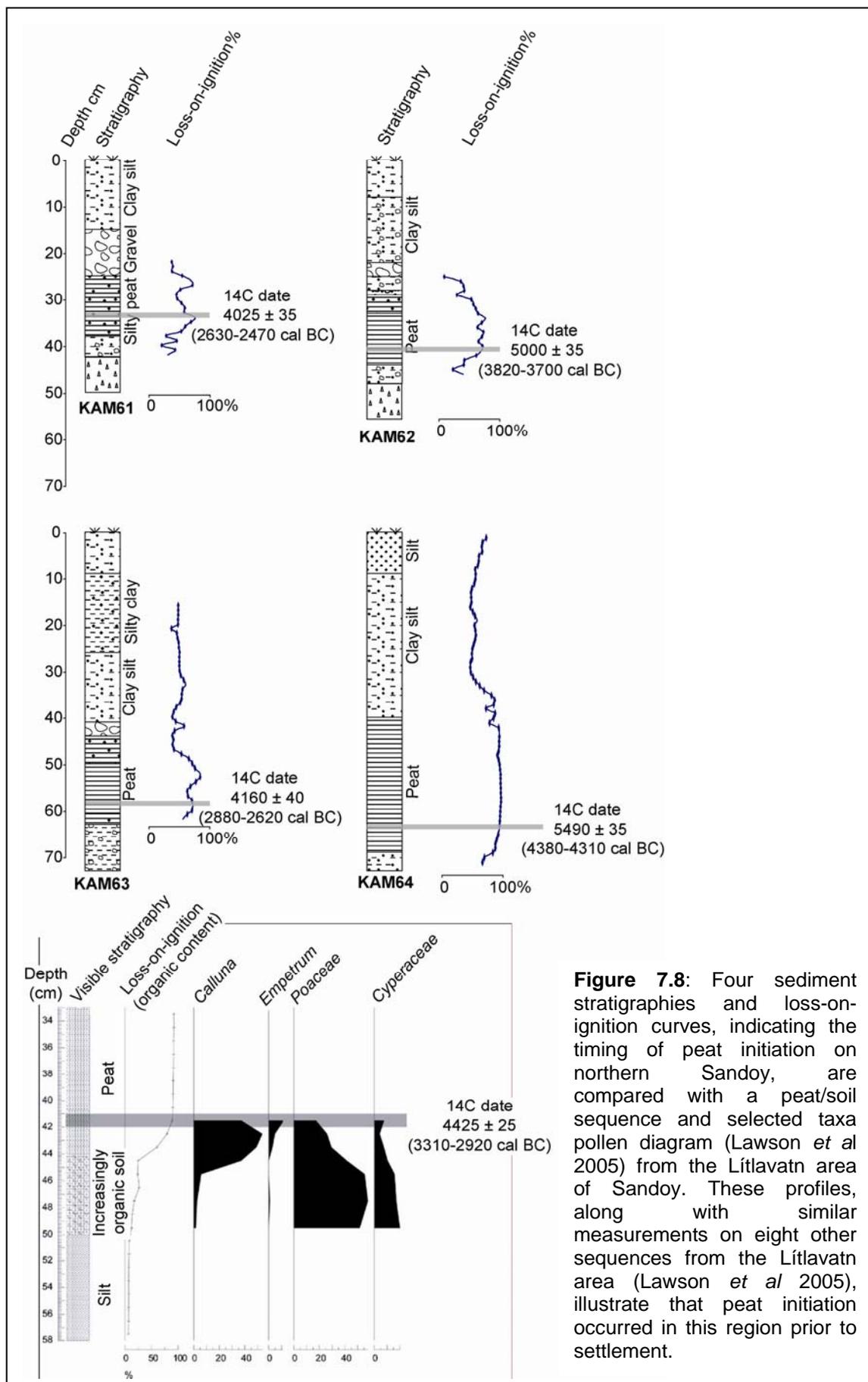
A major inconsistency in spatial patterns of degradation was observed between ENE and WSW facing slopes in north Sandoy (refer to Figure 6.12). The underlying substrate appears to be different on both slopes, with the ENE slopes characterised by a till-like substrate and littered with loose boulders, and WSW facing slopes characterised by a finer-grained substrate. The degradation of these surfaces is dependent on two processes; those that initiate the break-up of surface material or vegetation, and those that exacerbate erosion after the initial break-up of the surface. These processes are influenced by a combination of factors that might explain the difference in substrate and surface character. The degree of exposure affects both initial break up and subsequent exacerbation of erosion. With a prevailing south westerly wind, the initial expectation is that the WSW facing slopes, which are more exposed, should be more degraded. The landscape mapping evidence illustrates that the opposite is the case. This could be explained by anthropogenic factors or by natural factors such as variations in aspect, exposure and gradient. For example, the ENE facing slopes have generally shallower gradients than the WSW facing slopes. Steeper slopes are relatively well drained and less likely to become saturated leading to an initial break-up of vegetation. Steeper slopes may also be less exposed to wind erosion, although in the Faroe Islands, the extent of wind erosion may be inhibited by the damp climate and relatively stable soils. A further explanation could be that the supply of material to the contrasting slopes is different, as slopes of a moderate gradient may be more amenable to the build of fine material than more exposed areas. An alternative to the natural factors cited above is that different human influence caused contrasting patterns of erosion. This would have to be the result of a different human activity taking place in each location or that human activity was carried out more intensively at one location than another. Sheep grazing has been carried out at both locations but there is no evidence to suggest that grazing would have been more intense on the ENE facing slopes. Regardless of the cause of the slope characteristics, the

more eroded nature of the ENE facing slopes might imply that a threshold was crossed earlier than on WSW facing slopes. Transect 2, located on ENE facing slopes of Sandoy, does display evidence of earlier impact than at transect 1, although similar early changes are also noted on WSW facing slopes at KAM63.

Evidence of environmental thresholds in sediment stratigraphies

At sites on Suðuroy and Sandoy, peat accumulation has in the past been extensive and characterises many of the recorded profiles except for at high altitudes (above c.300-350 m). Mid-Holocene landscape stability is suggested by the widespread formation of peat on slopes of up to 40°, particularly observed around Hov on Suðuroy. Radiocarbon dating from close to the base of the oldest peat contexts on Sandoy, for example at KAM61, 62, 63 and 64, yielded dates of 4420-4580 cal yr BP, 5650-5770 cal yr BP, 4570-4830 cal yr BP and 6260-6320 cal yr BP respectively, indicating a mid-Holocene timing for the onset of peat accumulation at these sites. Initiation of peat development elsewhere in Sandoy has been dated to c.3200-5700 cal yr BP (Lawson *et al* 2005), which corresponds with the dating of peat initiation from transect 1a (Figure 7.8). The timing of peat initiation in the Faroes, occurring prior to the known arrival of people, contrasts with many situations elsewhere in the North Atlantic region, where human agency is implicated in peat initiation (e.g. Bennett *et al* 1997, Bunting 1996, Charman 1992, Moore 1975; 1993, Solem 1989). It is therefore presumed that the formation of peat at Faroese sites was facilitated by a relatively cool, wet climate leading to the progressive leaching of nutrients and acidification as the soils matured through the Holocene (Lawson *et al* 2005).

During the late Holocene, the peat accumulation begun in the mid-Holocene is disturbed by the influx and deposition of silts and gravels that reduce the organic content of sediments from around 80 % to around 40 % (e.g. KAM 61, 62, 63 and 64). This change is represented in some profiles by a clast rich layer but at other profiles by an influx of silts, sands and clays, crudely bedded at a centimetre scale. Although the sediments are locally variable, a relatively abrupt change from peat to silt/gravels exists in many sites on both Suðuroy and Sandoy, in a variety of geomorphic locations, implying regional scale disturbance as opposed to site specific or micro-topographic instability. The deposition of clast and minerogenic material implies that surfaces upslope of recorded profiles were stripped of their surface cover allowing inorganic material to be liberated. For destabilisation to occur on the scale recorded in the profiles, the bare sediment or peat needs to be exposed to the surface. This requires an initial breach in the surface vegetation cover, which can be caused by water logging, prolonged snow cover, or compaction and grazing by domestic animals. If unprotected by vegetation cover, peat is vulnerable to frost action and desiccation, and can be readily degraded by wind, rain wash and biochemical oxidation (Bragg and Tallis 2001).

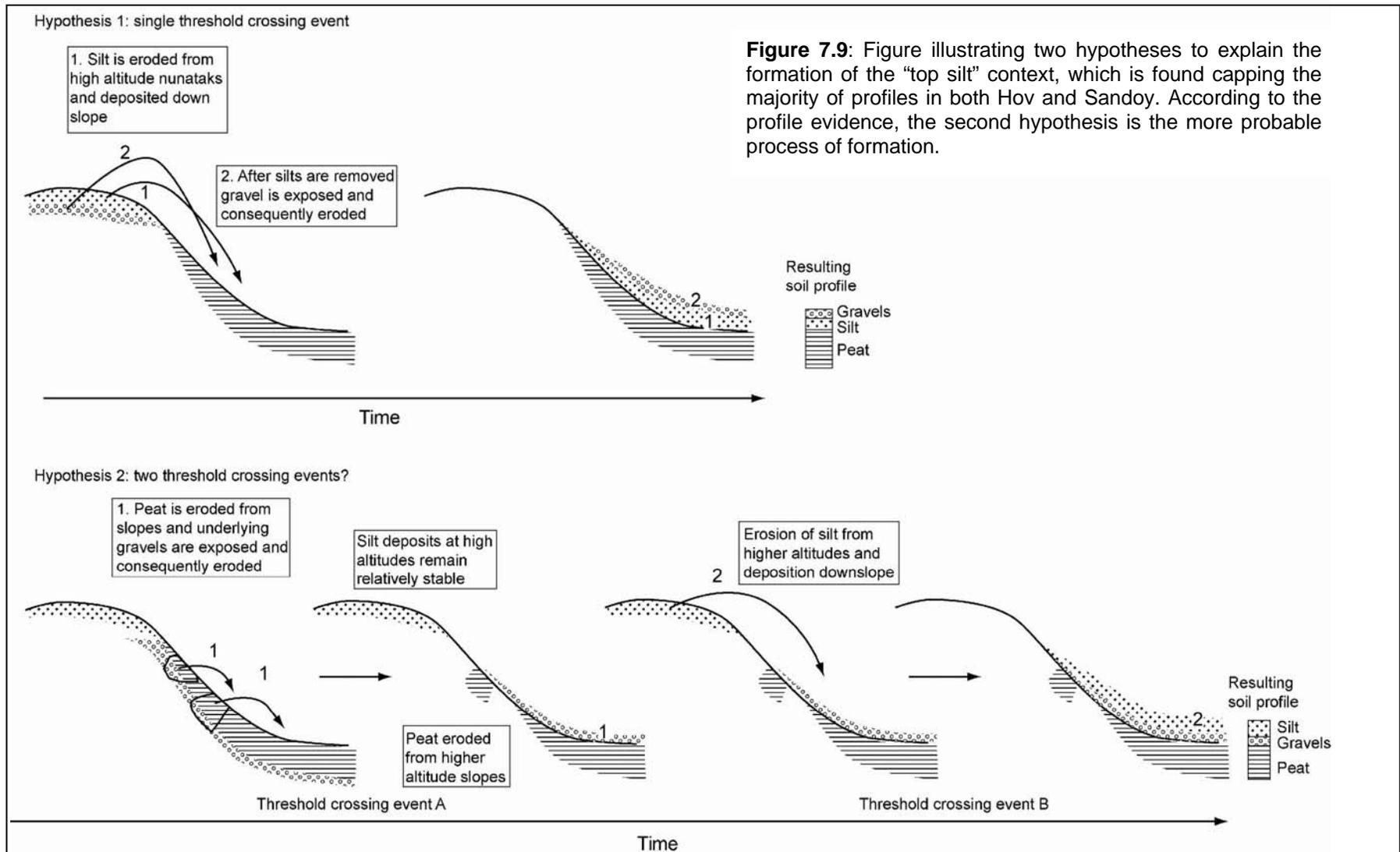


Where surfaces have been previously exposed, further degradation and the removal of loose material may be caused by wind, rain, snowmelt or frost action.

The distinct change in the profile from peat to silts/gravels represents a threshold crossing event in the Faroese landscape, after which the landscape was fundamentally altered. It may be that this change was an inevitable geomorphic development given the established natural conditions resulting from the island's history of deglaciation and predominantly cool wet maritime climate. Alternatively, this development could result from a specific perturbation such as anthropogenic impact. It is therefore key to determine whether this threshold crossing event was induced by natural or anthropogenic factors, in order to assess the extent to which people have impacted the Faroese environment, or not.

A second significant change in the near-surface stratigraphy and landscape is represented by a silt unit which lies directly over the older formations of peat and silts/gravels, and frequently forms the most recent unit in the Faroese soil stratigraphy. The top silt is widespread on both Suðuroy and Sandoy, as a discrete cm-scale, predominantly inorganic layer, and as a major minerogenic component in peats, and therefore marks a distinctive phase of geomorphological activity in the Holocene. The source areas for this unit are likely to be the highland silts formed on nunataks. Although upland silt deposits are most common in the north of the Faroes (Christiansen 1998), remnants also exist in northwest Sandoy (refer to Figure 6.13).

A key question about the top silt is whether this influx represents a new phase of geomorphic activity, i.e., the crossing of an environmental threshold, or whether the influx of fine silt represents a continuation of the phase of erosion and deposition initiated by the earlier influx of silts/gravels. Crucially, it is important to establish whether the formation of the top silt has been influenced by climatic factors such as the Little Ice Age or by anthropogenic activity. Two possible explanations are illustrated in Figure 7.9 (refer also to hypothesis 2 in Table 1.1). If gravels and (high-altitude) silts are triggered by a single geomorphic event, it is most likely that the silt would be eroded first from mountaintops/plateaux followed by the underlying gravel. In this case, the sediment profile would show silts overlying the peats and capped by gravel. Alternatively, the influx of gravel and later silt, may be the result of two separate processes. Initially, mid-high altitude slopes may be affected by peat erosion, exposing underlying gravels which are washed down slope, while glacial-age silts formed at high altitudes on nunataks are relatively unaffected. The second, and later process, would be the erosion of silts at high altitudes and deposition on slopes/at lower altitudes, capping the underlying peat and gravel layers. The sediment sequence evidence supports the latter process.



Timing of thresholds and possible causal relationships

To assess the hypotheses, radiocarbon dating was used to determine the timing of the major stratigraphic and landscape changes indicated by the sedimentary change from peat to silts/gravels and the initiation of the top silt layer. Three distinct phases, where the organic content of the profiles is reduced, were dated according to loss-on-ignition analyses and stratigraphic data. The proposed phases and accompanying dates are summarised in Table 7.1. The first phase (Phase 1), illustrated most distinctly at sites KAM 62, 63, 64, 70 and 75, occurs between c.2900-2300 cal yr BP (c.1000-400 BC) (Figure 7.10). A second phase (Phase 2a) of significant landscape change occurs less extensively than Phase 1, but is evident at sites KAM 63, 72, 73 and 74 and varies in timing from c.1900-1500 cal yr BP (60-400 AD) (Figure 7.11). Phase 2b occurs at profiles KAM 3, 20, 34, 61 and 62 and ranges from c.1500-1300 cal yr BP (c.400-660 AD) (Figure 7.12). Profiles KAM27, 28 and 67, which have alluvial locations, contain a different although complimentary, record of change that is consistent with the dates on profiles recorded from exposures on slopes. Alluvial profiles are characterised by stratigraphic sections of at least 1 m deep, with the base of the profile composed of clays, sands or gravels underlying a thick and rapidly formed poorly humified peat. The change from clay/sand/gravels to peat is abrupt, both in the profiles and the LOI curves of the aforementioned profiles. The abrupt transformations in LOI measurements occur at c.1280-1370 cal yr BP (c.580-670 AD) at KAM27 and at c.1360-1520 cal yr BP (c.430-600 AD) at KAM28, although peat formation begins some time prior to this and may be a response to changes occurring c.2900-2300 cal yr BP (c.1000-400 BC). Therefore, although the alluvial and slope profiles are different and are subject to different processes, they are probably responding to a similar external trigger.

Phase	Calibrated ¹⁴ C dates	Calendar dates	Change in sediment stratigraphies
1	c.2900 – 2300 yrs BP	c.1000 - 400 BC	Distinct decrease in organic material and an increase in the movement and deposition of silts and gravels.
2a	c.1900-1500 yrs BP	c.60 – 400 AD	Increased slope wash and deposition of silts, gravels and clays, similar to changes in Phase 1. Phase 2a changes not observed in Hov.
2b	c.1500 -1300 yrs BP	c.400 – 660 AD	Increased slope wash and deposition of silts, gravels and clays, similar to changes in Phase 1. Change from clay/sand/gravels to peat in alluvial profiles.

Table 7.1: Summary of the three phases of change as identified from the stratigraphic profile data, with key dates and associated changes in the sediment profiles.

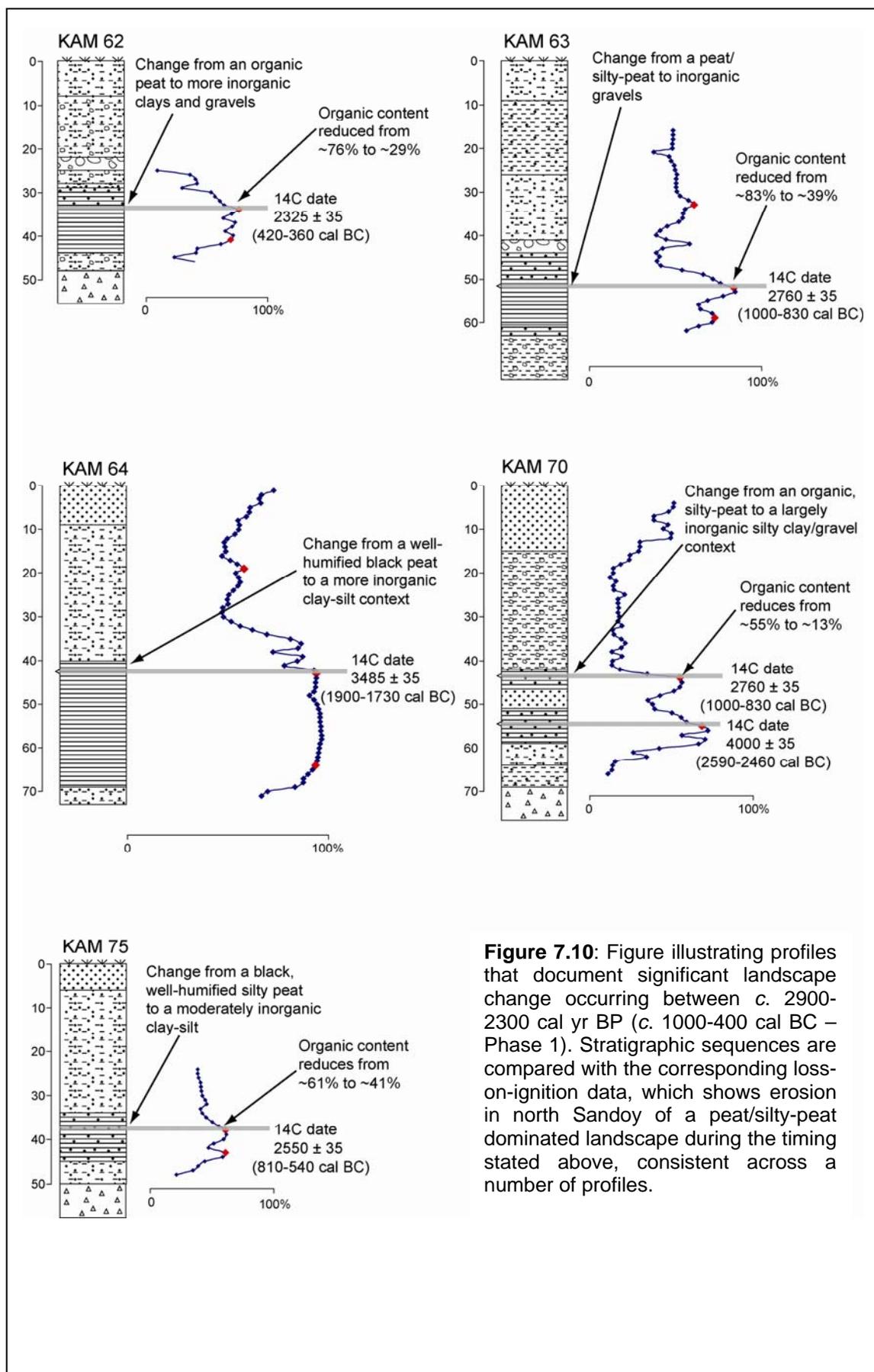
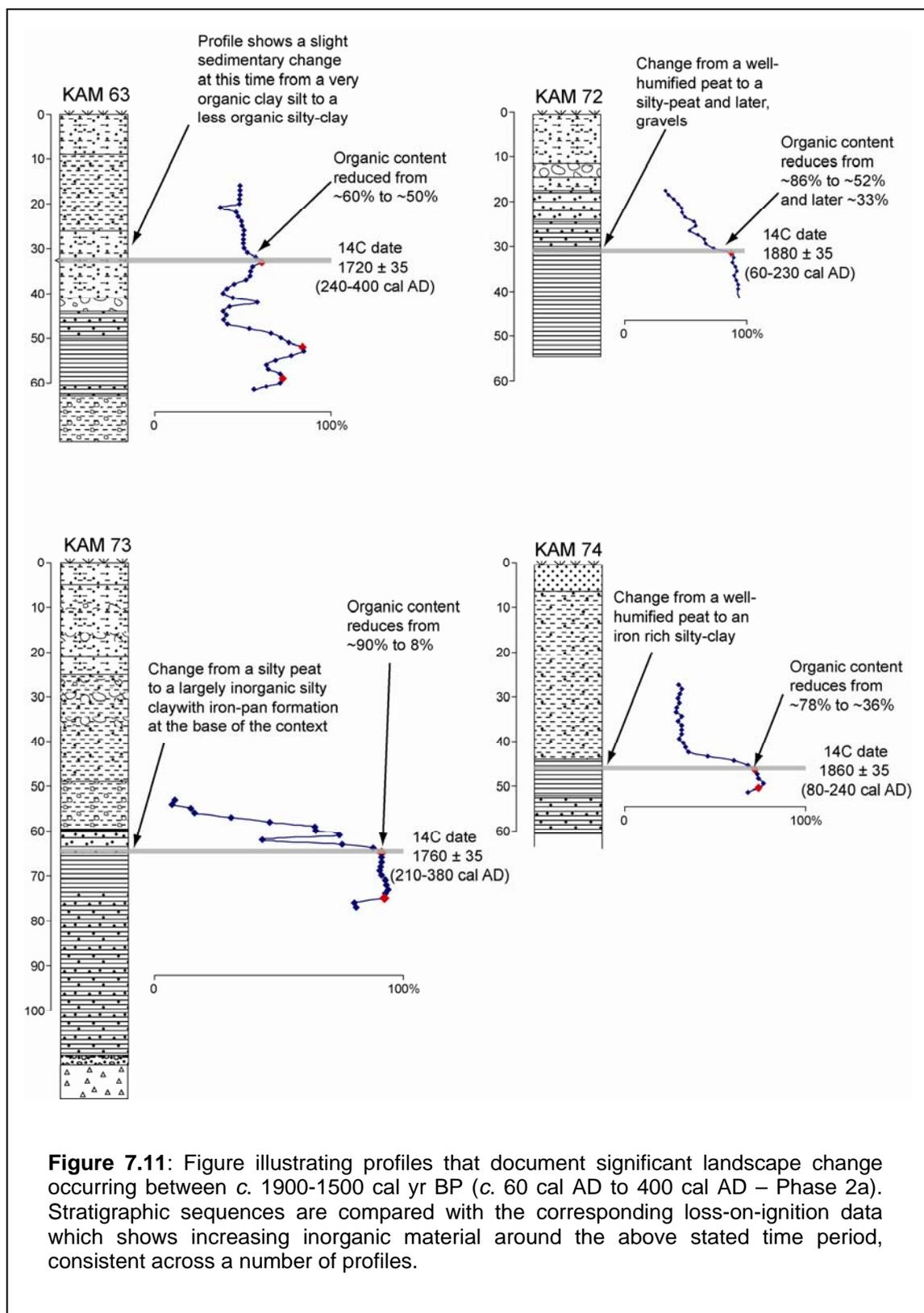


Figure 7.10: Figure illustrating profiles that document significant landscape change occurring between c. 2900-2300 cal yr BP (c. 1000-400 cal BC – Phase 1). Stratigraphic sequences are compared with the corresponding loss-on-ignition data, which shows erosion in north Sandoy of a peat/silty-peat dominated landscape during the timing stated above, consistent across a number of profiles.



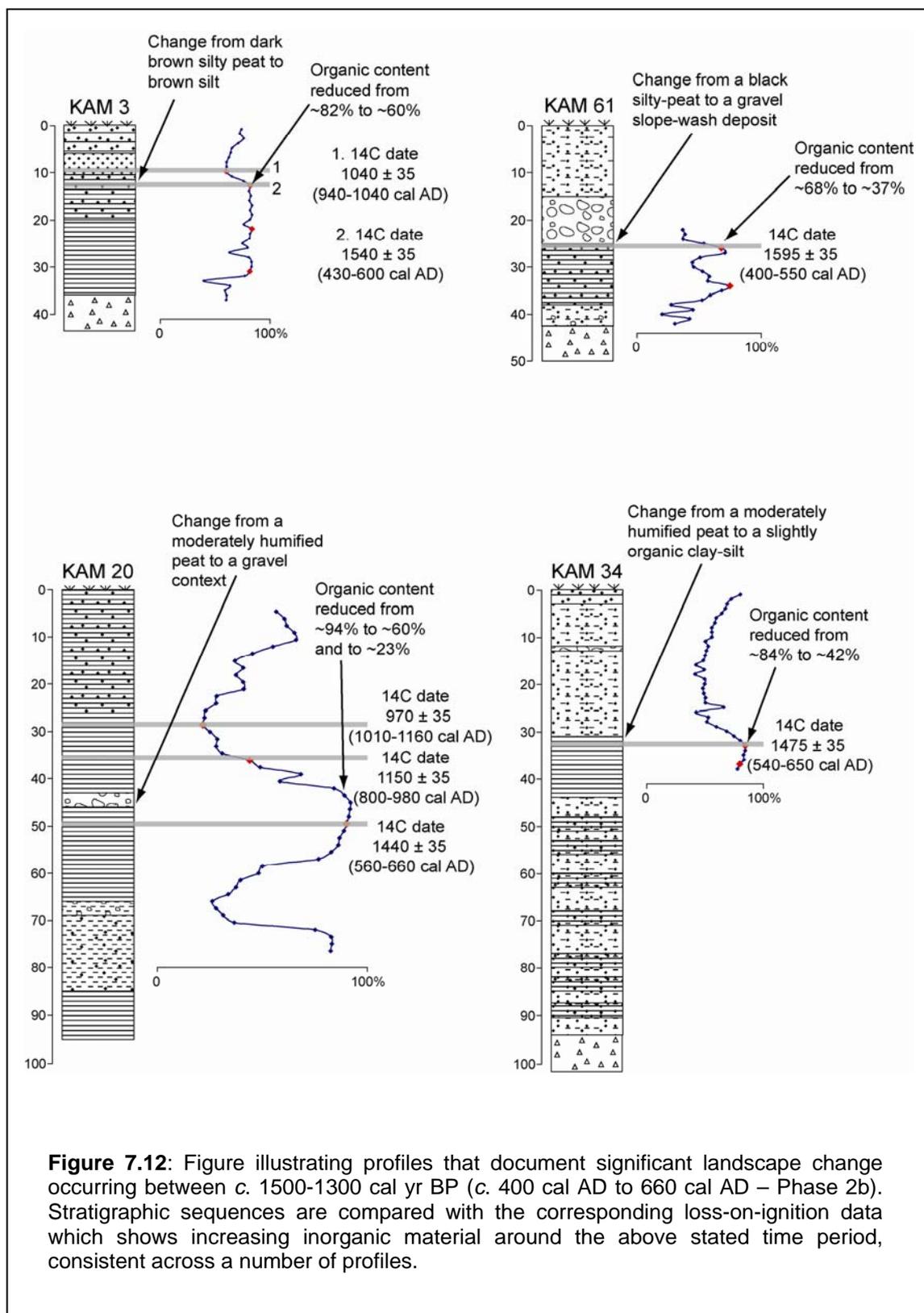


Figure 7.12: Figure illustrating profiles that document significant landscape change occurring between c. 1500-1300 cal yr BP (c. 400 cal AD to 660 cal AD – Phase 2b). Stratigraphic sequences are compared with the corresponding loss-on-ignition data which shows increasing inorganic material around the above stated time period, consistent across a number of profiles.

Phase 2a and 2b appear in the profiles as two discrete episodes of landscape impact. The earlier phase characterises some profiles and the later phase characterises others, but the two phases do not occur together in the same profile. Due to the resolution of the radiocarbon dating, it is difficult to ascertain if the two phases are related to a single external impact that is affecting different areas at different times, or whether the two phases are influenced by two distinct perturbations. The fact that both phases are not evident in the same profiles, and as there is no evidence of the earlier Phase 2a (c.60-400 AD) disturbance from any of the profiles sampled at Hov, might suggest that the two phases are the result of the same impact affecting different areas at different times, with impacts first occurring on Sandoy, and secondly at Hov.

Climatic, ecological and environmental changes coinciding with the timing of Phase 1 (c. 2900 – 2300 cal yr BP/ c. 1000-400 BC)

Phase 1 in the profiles indicates a pre-colonisation phase of landscape change, which is consistent with a pre-colonisation threshold crossing event indicated by hypothesis B in Figure 7.4. The timing of this change corresponds with some existing, albeit limited geomorphological and palaeoecological data from elsewhere in the Faroe Islands. Humlum and Christiansen (1998a) note that from about 8500-3000 cal yr BP, periglacial activity appears to have been relatively low, but increases in intensity after c.3000 cal yr BP. For example, increased debris cone activity occurs between c.3250-1965 cal yr BP, indicating increased periglacial activity and cooler temperatures. In Iceland, slope destabilisation and the inception of solifluction occurs after 2900 yr BP (Kirkbride and Dugmore 2005).

Significantly, at the time that the profiles are displaying signs of widespread geomorphic instability c.2900-2300 cal yr BP, there is widespread evidence for a pronounced period of cooling and more variable climate in the North Atlantic, although this period has been much debated (van Geel *et al* 1996; 1998). High resolution past surface temperature changes, applicable to the high-latitude North Atlantic region in the late Holocene, are indicated from ice core data. GRIP and Dye 3 reconstructions indicate that following a Climatic Optimum between c.8000 and 5000 yr BP, temperatures began to slowly cool, reaching a minimum around 2000 yr BP (Dahl-Jensen *et al* 1998). This correlates with the evidence of increased periglacial activity in the Faroes, as noted above (Humlum and Christiansen 1998a). A marked cooling around 3200 yr BP has also been recognised from other data sources in Greenland, including ocean sedimentary records (Møller *et al* 2006), pollen records (Fredskild 1983) and lake records (Funder and Fredskild 1989, Kaplan *et al* 2002, Kerwin *et al* 2004). Although air temperature change data can not simply be translated to areas outside Greenland (Dawson *et al* 2003), there is evidence supporting climatic changes at this time from elsewhere in the North Atlantic, which would suggest that deteriorating climate affected

much of north-west Europe. For example, a repeated southward incursion of ice-rafted debris associated with sea surface cooling of up to 2° C in the eastern North Atlantic as far south as northern Scotland, occurred about 2800 cal yr BP (Bond *et al* 1997). In the Nordic seas a cooling in sea-surface temperature (SST) of 1.5° C is recorded, starting at around 3000 cal yr BP and culminating in a SST low around 2100 cal yr BP (Andersen *et al* 2004). In south west Sweden, an increase in storm activity, indicating a dominance of cold and stormy winters and strongly fluctuating bog surface wetness, is identified between 2800-2200 cal BP (de Jong *et al* 2006). The storm activity increase in Sweden coincides with increases in sea-salt concentration, which are documented for the period 3100-2400 yrs BP in the Greenland GISP2 record (O'Brien *et al* 1995) and has been used as a proxy for storminess in the North Atlantic (Dugmore *et al* 2007a). Correlating with cooling SSTs are glacier advances at c.2750 yrs BP, reported from northern Sweden (Denton and Karlén 1973, Karlén *et al* 1995) and southern Norway (Dahl and Nesje 1994).

There is also an established view in the British Isles that at c.3200-2600 cal yr BP there was a marked change from a relatively warm, dry climate to a relatively cool, wet climate (Lamb 1977, Briffa and Atkinson 1997). This is supported by both pollen research that has highlighted evidence for deteriorating conditions after 3200 cal yr BP and tree line data (Birks *et al* 1996). Evidence from the Cairngorms in the Scottish highlands infers a marked decline in the treeline altitude after around 3500 cal yr BP, suggesting an onset of cooler, windier conditions (Dubois and Ferguson 1985). Vegetation reconstructions from three profiles spanning 425 km from western Ireland to northern England have been related to changing bog surfaces and phase shifts to a wetter and/or cooler climate, which occur in all three profiles at 3200 cal yr BP and 2750-2350 cal yr BP (Barber *et al* 2003). Recent geomorphological research in the Scottish highlands (Reid and Thomas 2006) also implicates climate forcing to account for increasing magnitude and frequency of slope destabilisation after 2700 cal yr BP, consistent with the timing of slope destabilisation in Iceland (Kirkbride and Dugmore 2005), with similar effects to that recorded in the stratigraphic and landscape data of the Faroe Islands. A timeline summarising the timing of these changes and comparing them with the Phase 1 changes observed in this research is presented in Figure 7.13.

It would be expected that the Faroe Islands would respond to climatic changes at this scale because of their position, situated at the meeting of warm and cold ocean currents which makes them particularly sensitive to the effects of temperature changes of the surrounding water (Hansen 1996). Therefore according to the stratigraphic and surface geomorphological evidence, combined with data from other research, it is proposed that a period of climatic variability, more specifically cooling temperatures and increased winter storminess and wetness, around 3000 yr BP, caused increased periglacial and other climate-related

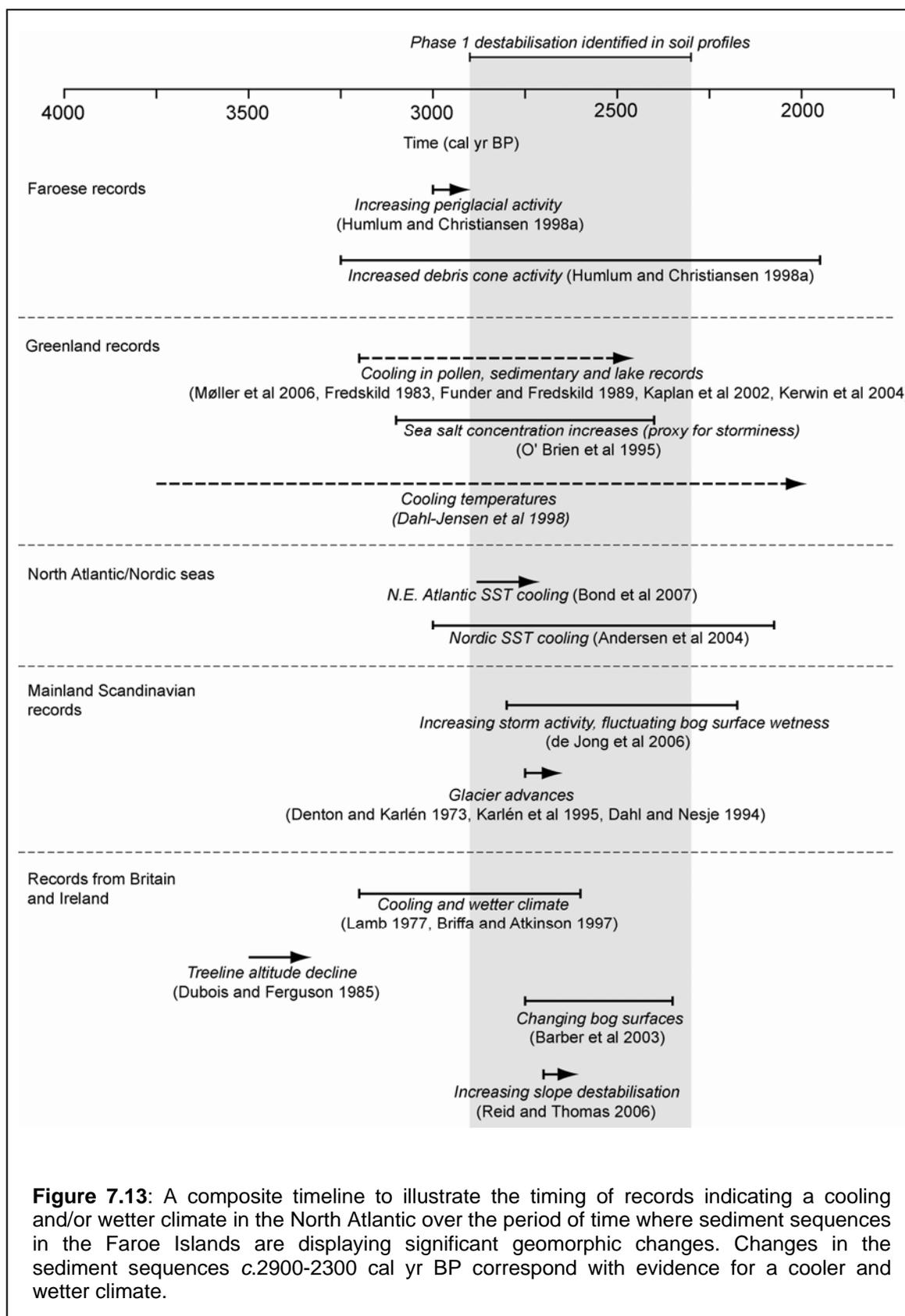


Figure 7.13: A composite timeline to illustrate the timing of records indicating a cooling and/or wetter climate in the North Atlantic over the period of time where sediment sequences in the Faroe Islands are displaying significant geomorphic changes. Changes in the sediment sequences c.2900-2300 cal yr BP correspond with evidence for a cooler and wetter climate.

geomorphic activity at high altitudes. This led to the breaching of the vegetation cover and consequent liberation of aeolian and fluvial sediments and gravels, resulting in deflation of high altitude plateaux. The influx of highly minerogenic material fragmented the uniform peat layer, transforming the previously peat dominated landscape into a more varied soil and vegetation surface.

Climatic, ecological and environmental changes coinciding with the timing of Phases 2a (c.1900-1500 cal yr BP/60 AD to 400 AD) and 2b (c.1500-1300 cal yr BP/400 AD to 660 AD)

Evaluating the timing and causes of the landscape change represented by Phases 2a and 2b is more difficult because the timing of Phase 2b, in particular, is coincident with the first indications of settlement as suggested by palaeoenvironmental data (Jóhansen 1979, Hannon and Bradshaw 2000, Edwards *et al* 2005). It is therefore more difficult to separate out those impacts that might be climatically influenced from those that might be associated with the initial impacts of people. In Iceland, tephrochronology allows both precise and accurate dating control to correlate cultural impact with landscape change (e.g. Simpson *et al* 2001, Dugmore *et al* 2000; 2006, Mairs *et al* 2006), but in the Faroe Islands, this is problematic. Firstly, although at least six Icelandic Holocene tephra layers are present in the Faroes, the majority are microscopic deposits of limited volume (Dugmore and Newton 1998, Persson 1966; 1967, Jóhansen 1975; 1982, Mangerud *et al* 1986), which makes it difficult to determine if the particles have been deposited *in situ* or have been reworked, therefore complicating the identification and application of the time-parallel marker horizons that make tephrochronology so effective in Iceland. Secondly, volcanic particles arrive in the Faroe Islands by routes other than fallout from volcanic plumes. The gradual rise in a background flux of tephra grains of mixed compositions in recent Faroese peats is probably due to the erosion of Iceland's soils, local erosion of Faroese peats containing older tephra, and reworking of pre-Holocene volcanic sediments from within Faroese tuffs (Dugmore and Newton 1998).

The lower resolution of radiocarbon dating techniques, combined with the relatively short profiles, complicates our understanding of the chronology of Phase 2a and 2b. However, several coincident dates confidently place Phase 2a to c.60-400 AD (c.1500-1900 cal yr BP). Phase 2a is unlikely to be a disturbance exclusive to Sandoy (although, to date, the best evidence is from here), because there is other evidence for environmental changes at this time elsewhere in the Faroes. For example, the reduction of organic matter in the stratigraphic profiles corresponds with a phase of heathland spreading and an associated peak of erosion dating from 250-400 AD, recorded from a lake core at Heimavatn on the island of Eysturoy in the northern Faroe Islands (Hannon *et al* 2005). A comparable peak in magnetic susceptibility dating to c.230 AD was also recorded at Gróthúsvatn lake on Sandoy

(Hannon and Snowball unpublished 2003, cited by Hannon *et al* 2005). Heathland spread, involving a shift from *Juniperus* and *Cyperaceae* to *Ericaceae*, has also been recorded around this time at various sites in the Faroes including Tjørnuvík on Streymoy in the northern Faroes (Hannon and Bradshaw 2000), Korkadalur in Mykines in the far west of the archipelago (Hannon 1997 unpublished, cited by Hannon *et al* 2005) and Argisbrekka on Eysturoy (Hannon and Bradshaw 2005). Although elsewhere in Europe the spread of heathland is most often associated with anthropogenic impact, such as in Shetland (Bennett *et al* 1992) and Norway (Kaland 1998), in the Faroes the local spread of heathland changes and a corresponding peak in slope erosion have been associated with a climatic driver (Hannon *et al* 2005). Heathland vegetation is influenced by differences in climate, geology, topography and soil type. Cool, wet impoverished conditions that inhibit the complete decomposition of organic material, and accumulations of acid humus that further accelerate leaching, may influence heathland vegetation, however, the development of heathland in the Faroes in the absence of anthropogenic interference would be a unique situation in Europe in the Holocene.

At the time these changes are recorded in the lake sediments (Hannon *et al* 2005), however, there is a lack of evidence for a climatic driver, such as decreasing air temperatures, increased storminess or increased precipitation, which is required to cause the spread of heathland and increased slope destabilisation. The period around 100 AD is notable for its warm rather than cold climate (Bianchi and McCave 1999) and has been referred to as the Roman Warm Period in the literature (Lamb 1995). A relatively abrupt incidence of climatic cooling is recorded around 450-500 AD (c.1500 cal yr BP), which has been identified by several palaeoenvironmental records, such as tree ring data from Finland (Eronen *et al* 1999), sea-surface temperatures based on diatom stratigraphy in the Norwegian sea (Jansen and Koç 2000, Andersson *et al* 2003, Bianchi and McCave 1999), Bond's event 1 in North Atlantic sediments (Bond *et al* 1997) and rising lake levels, increased bog growth and a peak in lake catchment erosion in Scandinavia (Berglund 2003) (Figure 7.14). However, the timing of this climatic deterioration occurs up to three centuries after environmental and vegetation disturbance indicated by Phase 2a is recorded in the Faroe Islands. Although the response of vegetation to climatic change can be rapid, as has been illustrated by vegetation response following the Younger Dryas (e.g. Kneller and Peteet 1999, Peteet *et al* 1990), a lag time of some sort would be expected between the onset of a cooling climate and the response of vegetation and soils. To account for the spread of heathland in the Faroes at c.250 AD, therefore, the climate would be expected to be deteriorating prior to this, yet the evidence is that the North Atlantic climate was relatively warm at this time. Therefore climatic deterioration is not easily reconciled with the geomorphic and vegetation evidence during this period and without more consistent high resolution dating and new evidence,

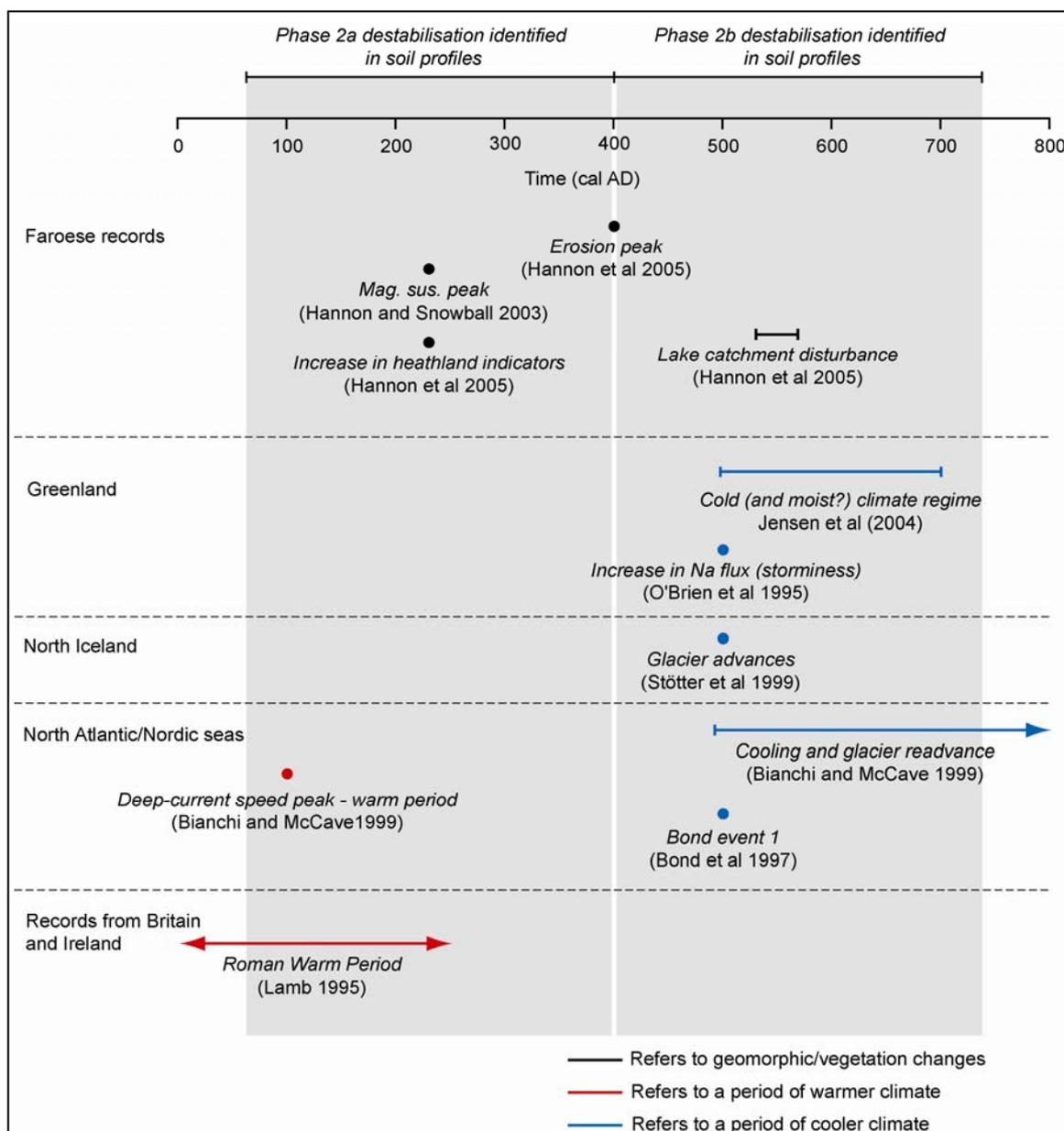


Figure 7.14: A composite timeline to illustrate the timing of geomorphic and vegetation records in the Faroe Islands and records indicating a cooling or warming climate in the North Atlantic, over the period of time where sediment sequences in the Faroe Islands are displaying significant geomorphic changes (phase 2a and phase 2b). Changes in the Faroes sediment sequences c.60-400 AD do not correlate with any periods of known climate cooling.

temperature changes cannot be definitively correlated with the observed landscape changes of Phase 2a.

With no clear indication of deteriorating climate at this time, other drivers that could be involved in the spread of heathland and the incidences of increased erosion, recorded by Hannon *et al* (2005) and in stratigraphic evidence from Sandoy, need to be considered. Naturally increasing acidification, which is related to a particular local combination of bedrock, soil and vegetation, is a possibility, but such changes would be difficult to distinguish from those arising from increasing rainfall. Furthermore, increased leaching does not account for the evidence of increased soil and slope erosion, which requires an external perturbation to breach the vegetation cover. Natural vegetation dynamics can also disrupt the balance between bedrock, soil and vegetation, but with the Faroes being largely devoid of trees in prehistory, this is unlikely to account for changes at an inter-island scale. Likewise, with a lack of indigenous grazing animals or mammals, natural dynamics within pre-colonisation animal populations such as birds, are unlikely to have contributed to the vegetation disturbance indicated at this time. Fires may induce vegetation change but are unlikely to have taken place on such a regional scale in the Faroe Islands and there is no evidence for significant and regional incidences of naturally caused burning.

A remaining alternative driver of this type of landscape change is human impact, and anthropogenic activity has been indicated as accounting for a similar spread of heathland elsewhere in Europe. At present, there is no firm evidence of settlement prior to the 6th century AD, but the fact that people were present in the islands before the Viking Age, as detailed by recent palaeoenvironmental research (Hannon *et al* 2005), suggests that an even earlier human presence may be possible. There are other interpretations of the palaeoenvironmental data that also suggest human occupation could have occurred earlier than the 6th century, in particular, the wide spatial extent of anthropogenic-related palaeoecological evidence from sites across the Faroes, including Tjørnuvík on Streymoy, Eiði on Eysturoy, Hov on Suðuroy and Mykines. The dispersed site locations producing environmental indications of early settlement reflect an extensive occupation of the islands by the 6th century AD. Therefore, pre-6th century human presence, either as a periodic exploitation of resources or through the introduction of livestock as a provisioning strategy, is a possibility. Without more precise and accurate dating and associated archaeological and climate evidence, the nature of increased erosion and vegetation change around 100-200 AD can not be conclusively determined. However the prevailing view that these changes are forced by increased storminess and declining atmospheric temperatures (Hannon *et al* 2005) does not confidently fit the chronology of climate change as is presently understood. The simplest alternative explanation is the early presence of people or livestock.

Phase 2b is dated to c.400-660 AD, and again this phase is contemporaneous with the limited evidence of vegetation and landscape disturbances recorded elsewhere in Faroe Islands in the 6th and 7th centuries (Hannon *et al* 1998; 2001; 2005, Hannon and Bradshaw 2000, Jóhansen 1971; 1979; 1985; 1995, Edwards *et al* 2005a) (refer to Figure 7.14). Some of the changes detailed can be unequivocally related to the presence of people, such as the appearance of cereal-type pollen and domestic animal bones (although the absence of these elements does not prove that people were also absent). Other palaeoenvironmental impacts at this time are not dependent on the presence of people, such as increases in erosion, but their occurrence in conjunction with unequivocal anthropogenic evidence is suggestive of human influence. The timing of the Phase 2b changes is also coincident with the timing of an abrupt climatic deterioration around 500 AD (1500 cal yr BP), which is identified by several sources that are referenced above. With awareness of the longer-term landscape trajectory for the Faroes and of the extent of geomorphic changes occurring c.2900-2300 cal yr BP, which may have de-sensitised later impacts, a smaller scale climate cooling in the 6th century AD may not have been significant enough to have caused the changes seen in the environmental record; high altitude areas most susceptible to climatic changes had already been deflated by changes pre-colonisation.

Conclusions: how did pre-colonisation landscape change affect settlement?

Within the relatively dynamic Holocene history of landscape change in the Faroes, there have been two significant thresholds crossed in the southern Faroe Islands of Sandoy and Suðuroy, occurring in the late Holocene. The most significant of these occurred prior to colonisation, between c.2900-2300 cal yr BP (c.1000-400 BC), and is characterised in soil stratigraphies by a distinct decrease in organic material and an increase in the movement and deposition of silts and gravels, indicating an increase in slope erosion. The timing of this landscape change correlates with widespread evidence for cooling air and sea temperatures, increased storminess, and an increase in extreme precipitation and wind events with climatic shifts in Greenland and the North Atlantic region. A second, less distinct threshold crossing, occurs later in the Holocene, c.1900-1300 cal yr BP (c.60-660 AD), as two different phases; an earlier phase c.1900-1500 cal yr BP (c.60 - 400 AD), and a later phase c.1500-1300 cal yr BP (c.400-650 AD). Both phases are typified by increased slope wash and deposition of gravels, silts and clays, similar in character to Phase 1. Significantly, Phases 2a and 2b may comprise a single threshold, which is crossed at different times in different places, as profiles are only characterised by one phase or the other, with Phase 2a not observed at Hov at all. The two phases are probably manifestations of a response to an equivalent trigger which affects the sites examined at different times, and in particular affects sites at Sandoy earlier than those at Hov. Climatic deterioration is proposed as the causal mechanism in existing research, but a period of climatic deterioration is not identified in North Atlantic

palaeoenvironmental records until c.500 AD, several centuries after the earliest dating of the Phase 2a landscape disturbance. The later erosion phase, c.400-660 AD, does correspond with this documented period of climatic deterioration but is also coincident with the timing of human settlement as illustrated by palaeoenvironmental evidence. Human occupation is the simplest alternative explanation for the documented increases in erosion but as yet there is no firm evidence of human occupation in the Faroes prior to the 6th century. The issue to be resolved, therefore, is whether people could have arrived on the Faroe Islands earlier than the 6th century AD. To account for the timing of landscape change, people or domestic animals would have needed to have arrived on the islands by at least c.200 AD.

The landscape impacts sustained c.2900-2300 cal yr BP (c1000-400 BC) were the most significant in terms of landscape change in the late Holocene. There is evidence that vegetation cover was stripped from higher altitudes and mountaintop locations so that these surfaces were already exposed to erosion prior to colonisation. As well as a landscape disturbance at this time being noted in the profiles, distinctive landforms such as the box gullies at Hov also indicate that geomorphic change took place on a greater scale prior to colonisation, while indications of geomorphic changes since colonisation are less significant in terms of landscape impact. With regards to the question of whether human or natural impacts have been the major determinant of the present day surface landscape, several key elements of the present landscape were already well established by the time of the arrival of people in the islands. In addition, pre-colonisation landscape changes would have reduced the sensitivity to settlement, as widespread pre-colonisation erosion at high altitudes and on slopes to some extent desensitised the environment to consequent anthropogenic change. The destabilisation of slopes could also have been beneficial in breaking up monotonous peats and creating areas more suitable for grazing.

7.3 Human impact in the southern Faroe Islands

The impact and geomorphic significance of *landnám*

The term *landnám* meaning “land taking” is used to refer to the Norse colonisation of the North Atlantic Islands. Identifying the nature and timing of Norse *landnám* or earlier colonisation is therefore crucial to our understanding of the extent to which people influenced the Faroese environment and in a wider context, crucial to our understanding of the nature and extent to which landscapes in general are influenced by human activity.

A typical response of landscapes to human settlement is an increase in erosion (Edwards and Whittington 2001), often as a result of the destruction of vegetation that binds together the top soil, caused by deforestation, cultivation, overgrazing or trampling. Although research

suggests that settlement impacted Faroese vegetation, resulting in the final removal of most woody vegetation, particularly birch and juniper (Hannon *et al* 2005, Edwards *et al* 2005), deforestation is unlikely to have been geomorphologically significant because pre-colonisation woodland densities were low. Pollen data from Sandoy indicates that anthropogenic impact on vegetation was both subtle and gradual (Lawson *et al* 2005) with a lack of evidence for abrupt vegetation change. The impact of early cultivation on the wider Faroese landscape is also negligible, as the extent of land that can be cultivated is severely limited by the mountainous and sloping topography, the small-scale island geography and a cool, wet climate. Erosion and significant *landnám* or colonisation impacts resulting from deforestation and cultivation are therefore restricted, but erosion caused by the introduction of domesticated livestock would be expected to have been more significant. The islands at the point of settlement would have been well suited to grazing, because of the open grassy slopes and plateaux (the former which provided excellent grazing because of guano nourishment by the abundant sea birds) and the lack of predatory mammals.

Over-grazing, is a considerable cause of soil erosion, as has been shown to have been the case not only in North Atlantic and other island environments, but in countries and continents around the world. The introduction of grazing animals to the Faroes with the first settlement is, therefore, likely to be the key element of colonisation impact. The impact of grazing is dependent not only on the absolute numbers of livestock introduced, but also on how that livestock is managed, taking into account factors such as the quality of shepherding, where livestock is allowed to graze, and at what times of the year grazing takes place. Livestock introduced by the first Faroese settlers may have only been in limited numbers as they are likely to have had boats with limited cargo capacity. Furthermore, the number of cattle introduced to the Faroes is limited by the extent of fodder that can be grown, although sheep and goats could be over-wintered in the outfields. There is also the possibility that the introduction of livestock may have been a precursor to permanent human settlement.

In the soil profile it is difficult to identify the specific impacts of *landnám* while the dating of *landnám* remains disputed. What is evident from the soil stratigraphy is that no specific geomorphic disturbance, such as an abrupt deposition of gravel or initiation of a longer-term influx of silt material, is evident in the profiles around the 9th century. This is, however, what would be expected if *landnám* was significant, and if the islands were settled in the 9th century, as is generally accepted. This has various implications; firstly that landscape evidence for 9th century changes exists, but that the profiles were recorded from locations where that impact wasn't identifiable. This is unlikely given the range of profiles and the varied locations at which they were recorded. Secondly, it is possible that there are dating errors, but again this is unlikely given the number of dates taken on a wide range of samples and considering the range of corresponding dates from other palaeoenvironmental research,

both in the 6th century and earlier. Colonisation, or at least human interference in the islands through the introduction of livestock, therefore either occurred at an earlier date, in the 6th century or earlier, which is endorsed by geomorphic impact recognised in the sediment profiles, or alternatively, *landnám* disturbance in the 9th century was not significant enough to cause an impact recorded by the sediment profiles. The latter outcome would, however, be contrary to most other island colonisation research where settlement impacts are recognised in the environmental record by an increase (even if limited) in soil and slope erosion.

The formation of the top silt illustrated by the sediment profiles (refer to Figure 7.9) is crucial to understanding the geomorphic significance of colonisation/Norse *landnám*. If the colonisation of the islands by people caused the erosion of silts from higher altitudes and their deposition at lower altitudes, then colonisation has had a significant impact, enough to cause a threshold crossing event. If the formation of the top silt is the result of natural factors, such as a deteriorating climate in the Little Ice Age, then colonisation has had a limited impact. The stratigraphic data indicates a second disturbance following the initiation of peat erosion and deposition of gravel occurring c.2900-2300 cal yr BP, which supports the second hypothesis illustrated by Figure 7.9 and the alternative hypothesis 2 in Table 1.1. Plausible triggers for the erosion and deposition of silt are human impact in the 6th century or earlier, or deteriorating climate in the Little Ice Age beginning around the 13th century (Grove 1988, Mann *et al* 1998, Jones *et al* 1998, Bradley and Jones 1993, Hughes and Diaz 1994, Crowley and Lowery 2000, Lassen *et al* 2004). The onset of the Little Ice Age is, however, inconsistent with dating of the profiles which indicates silt influx in the profile and formation of the top silt prior to the onset of the Little Ice Age.

Therefore early colonisation impacts, although more limited than previously climatically driven impacts, are significant in terms of the wider Holocene Faroese landscape and represent a second threshold crossing event in the longer-term environmental trajectory. There is, however, little environmental evidence for a significant Norse *landnám* in the 9th century.

The geomorphic significance of post-*landnám* anthropogenic impact

When previously uninhabited islands are first colonised by people, initial impacts may be considerable as the environment initially responds to new and additional pressures. Initial impacts are generally characterised by a relatively abrupt and significant increase in sediment erosion and accumulation. Long-term anthropogenic impact, although of lower magnitude, is also significant, because impacts are able to accumulate over a longer period, shaping the landscape gradually but continuously. It is therefore useful to consider how anthropogenic activities and their impacts accumulate over the course of settlement. One

hypothesis is that human impacts diminish through time as people adapt their subsistence practices to the specific landscape, geographical and climate conditions of the islands. An alternative hypothesis is that human impact accumulates and increases because populations grow and people continue to carry out activities that may be environmentally unsustainable over millennial scales. Natural factors, such as climate, may also exemplify human impacts unless subsistence strategies are amended (refer to hypothesis 5 in Table 1.1). Figure 7.15 illustrates four hypothetical landscape trajectories showing how impact may change over human settlement, in terms of both initial colonisation impacts and longer-term settlement. Figure 7.16 conceptually explores the range of outcomes of human impact based upon the initial natural capital available to the settlers in the Faroe Islands.

Due to the resolution of the stratigraphic profiles over the timing of human interaction in the Faroes, and because these activities have accumulated slowly over a longer-term period and cannot be observed as abrupt changes in the sediment profiles, it is difficult to identify specific changes that may be associated with anthropogenic impact. However, by addressing alternative scales of landscape change, such as the spatial pattern of degradation indicated by vegetation cover, landscape change at a localised scale is highlighted. Archaeological and ethnographic data also illustrate evidence of human activity and their possible effects on the landscape and can be used to develop an understanding of how cultural activity may have been environmentally significant at different landscape scales. As deforestation and cultivation impacts over a longer-term period are unlikely to have been significant in terms of environmental change and impact, the following discussion will focus on impacts of grazing and resource exploitation, particularly that of peat.

The significance of long-term grazing impacts

Sheep have been the dominant form of livestock in the Faroes since settlement, and although cattle and pigs also comprised a significant percentage of domestic animals in the Norse period (Church *et al* 2005), sheep grazing has been the most important cultural and economic activity prior to the rise of the modern fishing industry. Sheep have been important economically, with wool the most important Faroese export prior to the rise of the Faroese fishing industry in the 19th century. Sheep also provide a continuity of cultural meaning as they are present in nearly all aspects of Faroese life. For example, economic and legal order since the 13th century have been near synonymous with rules and regulations concerning sheep management and the raising of hay for sheep (Gaffin 1996). With such an emphasis on sheep, and with sheep-related activity so dominating Faroese culture and economy, it would be reasonable to suggest that grazing of livestock, particularly sheep, would also dominate the post-colonisation landscape record. Grazing has the potential to affect a wide geographical area and spectrum of altitudes, sparing only the more inaccessible peaks and

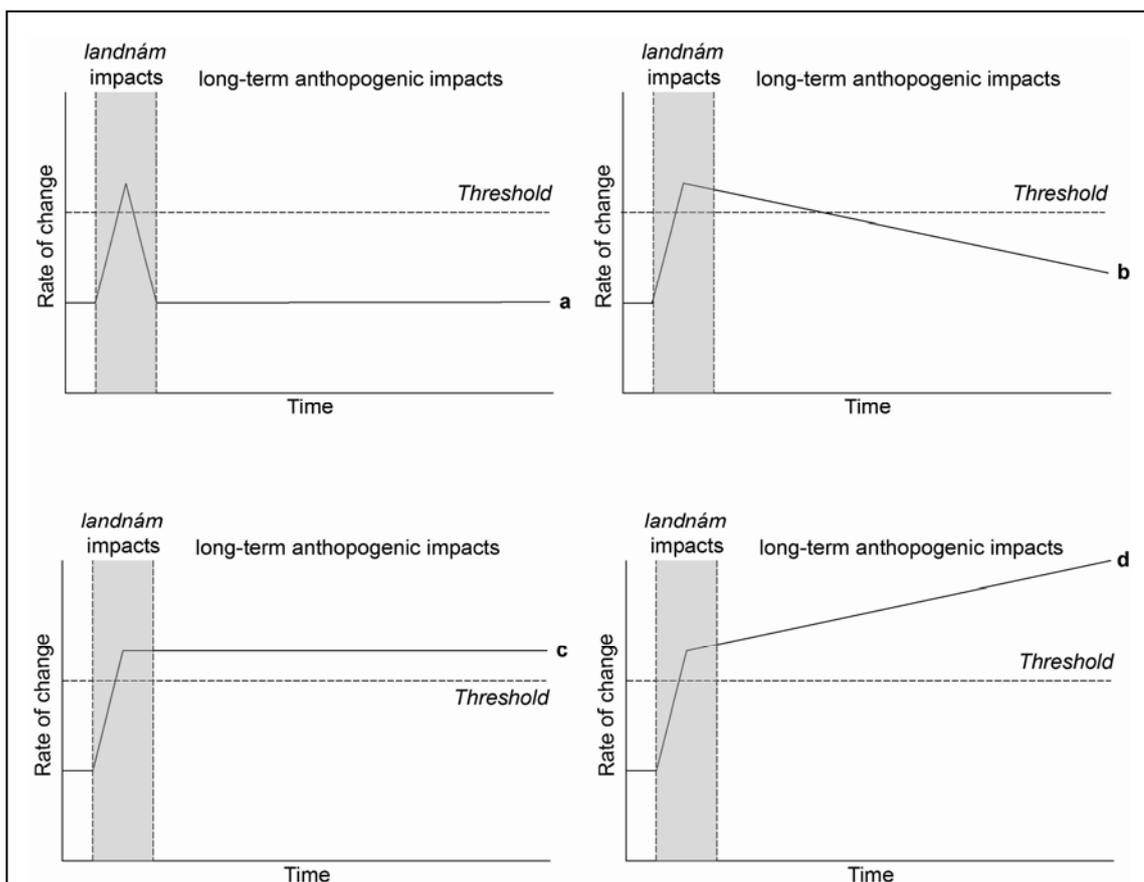
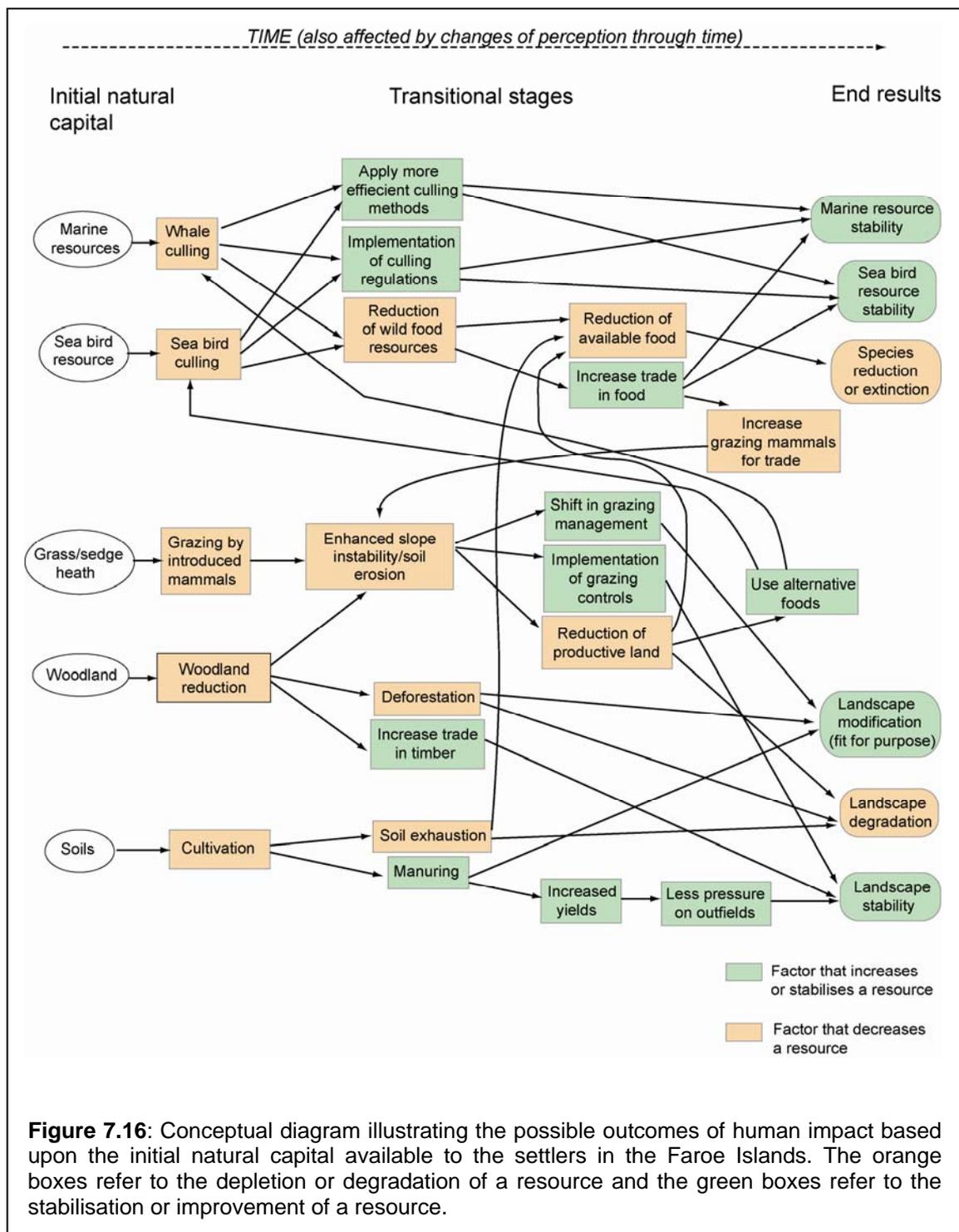


Figure 7.15: Conceptual figures which illustrate four possible hypotheses or scenarios of the trajectory of landscape impact over human settlement, in terms of both initial colonisation impacts and the trajectory of longer-term settlement impact. In hypothesis **a**, colonisation has an initial impact on the landscape but this is limited. A threshold is not crossed permanently and a pre-colonisation trajectory continues post-colonisation. In hypothesis **b**, a threshold is crossed immediately after colonisation, but impacts reduce through time over the period of long-term settlement. In hypothesis **c**, a threshold is crossed immediately after colonisation but impacts stabilise at a new trajectory over the course of long-term settlement. In hypothesis **d**, a threshold is crossed with colonisation and rates of landscape change proceed to a new trajectory, with rates of change continuing to increase over the period of long-term settlement.



gullies, and would impact across a long time continuum beginning with initial settlement. If not effectively managed, sheep grazing can lead to compaction and breaching of the vegetation cover, reduced infiltration and increased runoff. This results in increased soil erosion and long-term landscape degradation, which has been demonstrated in the environmental records of other North Atlantic environments, particularly Iceland (e.g. Arnalds 1987, Simpson *et al* 2001). The continuing influx of silt forming a top soil in sediment stratigraphies may be related to the impact of grazing, but rather than the organic content of the soil decreasing, which would be expected if grazing intensified over settlement, LOI profiles in Hov show an increasing soil organic content from around the 12th century (e.g. KAM3 and KAM20).

Geomorphic mapping of surface degradation also illustrates the extent of erosion potentially attributable to grazing. Although surface erosion is not visible on the same scale in the Faroes as it is in Iceland, altitudes above 350 m on north Sandoy, which are subject to periglacial activity, are heavily degraded. Underlying till or bedrock is exposed and less than 10 % vegetation and soil cover, in terms of area, remains. Between altitudes of around 100-350 m, vegetation cover generally comprises around 40-60 % of the landscape surface, although at certain locations especially on south west facing slopes, slopes are well vegetated to altitudes of 350 m. Except for a few exceptions close to the settlement of Sandur where surface degradation has occurred, low altitude locations (i.e. <100 m) are 90-100 % vegetated (refer to Figure 6.9).

The sediment stratigraphic and surface landscape evidence suggests that although grazing probably triggered an initial increase in soil erosion, this remained on a small scale, and may even have decreased through the settlement period. Other research conducted on this subject in the Faroes is limited, but has concluded that grazing pressure was probably insufficient to contribute to major and rapid change in vegetation cover and therefore would not have contributed significantly to historic soil erosion (Thompson *et al* 2005, Humlum and Christiansen 1998a). Modelling of livestock rangeland areas in the outfields of Hov, Sandur and Leirvík (Eysturoy) indicates low numbers of stock relative to the carrying capacity. This suggests that although usable biomass declined with the onset of grazing activity, it was not at a level that would cause major changes in vegetation cover or contribute to soil erosion, even under climatically determined poor growth conditions (Thompson *et al* 2005).

There is also geomorphological evidence within the field site locations to suggest that early on, the settlers made improvements to the landscape to increase productivity, although this had mixed results. Relic drainage ditches were observed in the outfields of both Porkeri, close to Hov, and on Sandoy. In Sandoy, one of these drainage ditches extends from an altitude of c.274 m to c.180 m at a diagonal to the slope, cutting through a landscape which

is now in places almost completely degraded (refer to Figure 6.23). This suggests that at the time the ditch was created, this area of the landscape was still vegetated and required drainage, implicating erosion since colonisation. A more detailed study was made of a relic drainage ditch and associated gully system on north facing slopes in the Porkeri outfields near Hov. The base of the ditch cutting (refer to profile KAM9 and Figure 6.4) has been dated to 1120 ± 35 yr BP (858-996 AD) (GU-11661), indicating that drainage as a system of land management was underway comparatively soon after settlement. Although the existence of the ditch indicates that the settlers tried to improve the quality of land for grazing, a series of small gullies that run into the ditch and that have therefore developed after 858-996 AD are evidence of some small scale landscape impact that has occurred since the cutting of the ditch. It is probable in both of the above cases that although the draining caused localised landscape degradation, the landscape was improved for grazing by the replacement of a peat/moss cover with a more bio-diverse grass dominated cover.

The significance of landscape impact related to resource exploitation

With a lack of wood in the Faroe Islands to use as fuel or building material, peat cutting can be assumed to have taken place since initial settlement. Peat has provided a principle source of fuel in many Atlantic island environments where woodland has been limited, for example in the Shetland Isles, the Western Isles of Scotland, Ireland and the Falkland Islands. Impact from peat exploitation would be expected to be manifested differently in the landscape record from grazing impacts. The effects of grazing are assumed to be more or less ubiquitous across the outfield landscape, with higher altitudes more vulnerable because of their increased sensitivity to impact. Peat cutting, on the other hand, was carried out within spatially explicit areas, firstly according to where peat had developed, and secondly dependent on locations with easy access from nearby settlements (either overland, or near a suitable landing place for transportation by boat). As a result, peat cutting would not be expected to cause such spatially widespread impacts as grazing, or to cause impact at high altitudes, and accordingly would only be illustrated in specific and localised sediment sequences.

There is evidence of peat erosion in the form of peat-hagged landscapes, for example, in Hovsdalur, and of former peat banks, especially in Sandoy. Peat erosion is influenced by topography, drainage, fire, slumping, bog bursts, wind and overgrazing as well as by peat cutting. However, peat erosion can be observed in conjunction with archaeological structures related to peat cutting activity thus implicating anthropogenic influence. In a walk-over archaeological survey undertaken in 2005, *kráir*, three or four sided roofless structures used for storing peat (refer to Figures 6.22b-c), were mapped in designated areas of the Sandoy outfields. When cut, peat was dried and stored *in situ* and only transported back to the

settlement in small batches every two or three days as and when it was required. Peat was therefore dried and stored in *kráir* in close vicinity to where it was cut. As a result, the deflation of the surface landscape directly surrounding *kráir* can be explicitly linked to the act of peat cutting.

Although over time, partial or total regeneration of former peat cut surfaces may occur, in some cases the turf as well as the peat beneath may have been stripped (G. Bjarnarson *pers. comm.*). This limited the re-growth of grass and may have caused complete degradation of localised areas of the landscape. Peat cutting can also cause pooling of water leading to water logging, which escalates the processes leading to landscape degradation. Although peat banks provide evidence of peat cutting over the last hundred years, earlier peat cutting has stripped entire areas of vegetation and peat down to bedrock resulting in small patchy areas of landscape deflation in specific locations. The place-name *Árnheiði*, found north of Gróthúsvatn, refers to an area used previously for peat cutting; *heiði* means "heath" and *Árn* is a personal name. The status of this location as a former peat cutting area was also confirmed in local interviews (G. Bjarnarson *pers. comm.*). Today the landscape around *Árnheiði* is eroded down to bedrock, despite its low altitude location at c.50 m. Significantly, there is limited degradation elsewhere on Sandoy at altitudes below 100 m (refer to Figure 6.9), suggesting that degradation of the wider *Árnheiði* area has been anthropogenically as opposed to climatically induced, in which case, a much larger area would be affected. Figure 7.17 illustrates the comparison and correlation between degradation at low altitudes with areas used for peat cutting as cited by Sandoy interviewees.

This suggests that other low altitude locations may also have been degraded by peat cutting. Comparison of the geomorphic map with the archaeological survey and data from interviews identifies the locations likely to have been affected and possibly degraded as a direct consequence of peat cutting. Therefore, although human impact is not ubiquitously obvious, at the localised landscape scale it has been significant.

Conclusions: how has human impact affected the Faroese landscape?

In summary, human impact, both short-term caused by colonisation, and longer-term impact caused by continuous anthropogenic activities, have been limited in comparison to examples of settlement impact on other islands, e.g. Iceland, Easter Island. Colonisation impacts may be identifiable in the sediment profiles and probably contributed to the formation of top silt, which represented a fundamental change in the late Holocene Faroese landscape at a threshold crossing scale. Changes caused by colonisation were, however, overshadowed by earlier climatically induced impacts that were of a greater magnitude.

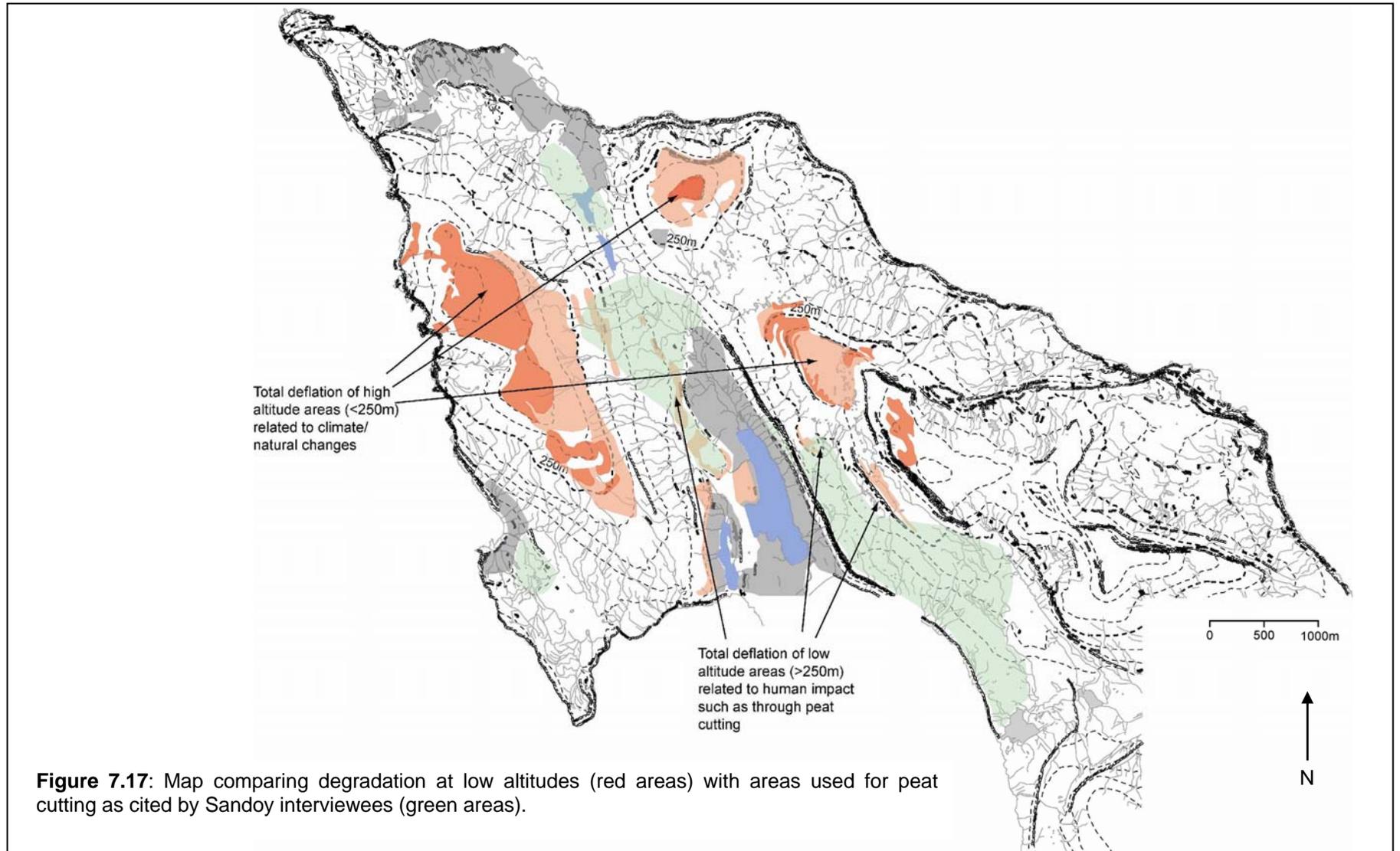


Figure 7.17: Map comparing degradation at low altitudes (red areas) with areas used for peat cutting as cited by Sandoy interviewees (green areas).

Longer-term anthropogenic impacts are more difficult to identify in the sediment profiles. LOI data illustrates that the organic content of the top silt increases as settlement develops, indicating that erosion did not necessarily increase with accumulating human impact and suggesting that the settlers were relatively well-adapted to their local environment. Surface landscape, archaeological and ethnographic data does however confirm that although limited, some small-scale, localised degradation has taken place over the course of settlement, as a result of peat cutting, as well as that of grazing.

Comparison between the spatial patterns of human activity (identified from the archaeological survey and interviews) and the extent of landscape degradation at low altitudes (i.e. where degradation is not principally determined by climate/exposure), illustrates a complex relationship between erosion and human activity. For example, areas with a high density of stone/turf dykes and *ból* (e.g. Zones 1a in Hov and Sandoy), are some of the best vegetated in the outfields. The predominant anthropogenic activity carried out in these areas was for keeping cattle, and the landscape was probably improved by manuring. By contrast, areas with a high concentration of *kráir* or that are known to have been used for peat cutting, are generally the most degraded areas in the lower-altitude outfields.

7.4. Why might human impact in the Faroes have been limited?

The lack of available evidence for major anthropogenic impact may be related to the collection of data from locations unlikely to have been impacted by anthropogenic activities or from where natural geomorphic processes dominate. However, as methods were used that targeted a varied range of activities, in areas of the landscape most likely to be affected by human activity, the absence of evidence is unlikely to be a factor limiting the evidence for human impact on the landscape. Secondly, considerable anthropogenic modification to the environment may not have been possible or necessary given the dynamic, natural pre-colonisation environment. In other words, the inherent properties of the landscape may have effectively minimised the environmental impact of the settlers. This may be in part due to characteristic features of the Faroese landscape, such as the relatively robust histosol and entisol soils, which, when considered in comparison to islands with more sensitive volcanic soils such as Iceland, would have been less sensitive to erosion. Vegetation may also have been relatively robust against settlement, as the predominant pre-colonisation vegetation consisted of grasses, sedges and ericaceous shrubs that are capable of tolerating grazing. Only the tall herbs and a small population of juniper and tree birch are likely to have been affected by the introduction of domesticates (Lawson *et al* 2005, Hannon *et al* 1998, Hannon and Bradshaw 2000). In addition, as trees only made up a very small percentage of vegetation cover in pre-colonisation Faroes, the landscape was predominantly open and already amenable to grazing. There was less of a requirement for the settlers to make

immediate alterations to the natural environment, such as the extensive forest clearance that led to high levels of soil erosion following the settlement of Iceland. In contrast, woodland reduction has had a comparatively minor impact on the Faroese landscape.

Although the open and dynamic environment of the Faroes may have limited anthropogenic impact in the outfields, the settlers themselves may have contributed to minimising their environment impact by inaugurating a subsistence strategy that minimised impact. Although in the Faroes colonisation has a regional impact, and local impacts cause significant degradation, human impact over the longer-period of settlement remains constant or diminishes. This suggests that the settlers to some extent adapted their subsistence routines to the specific landscape, geographical and climate conditions they encountered in the Faroe Islands. This is important because the Faroes were the first of the North Atlantic islands to be colonised by the Norse and were the first "pristine" landscape to face the Norse settlers on their westwards colonisation. The challenge was to adapt to this new environment, based on their experience of a traditional west Norwegian pastoral economy, so it could be asked this was achieved more effectively in the Faroes than in Iceland or Greenland, and why. Using archaeological, ethnographic and historical evidence, the following discussion will explore how, in the Faroes, adaptation to the local geography and effective resource exploitation may have minimised their influence on the landscape.

How geography, topography and settlement factors may have influenced environmental and cultural trajectories in the Faroe Islands

The geography and topography of the Faroe Islands, which are dominated by protected fjords and sounds, high sea cliffs, steep sloping mountains and rocky crags, would have influenced human activities by influencing the location of farms and villages, the nucleated settlement pattern, the arrangement of the infields and outfields, cultivation practices, access to the sea and communication across the islands including the mobilisation of people for communal activities such as the *grind* (pilot whale drive). The requirements of a typical settlement in the Faroes have been summarised by Small (1969) and include access to the sea with a reasonable place to pull up a boat, a patch of fairly flat, reasonably well drained land suitable for a farmstead and with the potential for some grain cultivation, and extensive grazing areas, as the poor vegetation would give a relatively low carrying capacity. Sheltered access to the sea would have been essential for subsistence fishing, access to marine resources such as whales, seals and seaweed and travel and communication with other villages, which were often more easily accessed by boat than by foot over the mountains. Locations favourable for barley growing were those that received the most sunlight and had good soil drainage, hence south and east facing slopes would have provided the best home

field sites during the settlement period. Grazing land quality differed between islands, which may also have been a factor in influencing early settlement locations (Thompson *et al* 2005).

Given these requirements and considering the general topography and geography of the islands, there appear to be relatively few sites in the Faroes favourable to settlement (refer to Figure 4.8). This would help explain why settlement patterns have changed so little over time. Comparison between the extent of present day settlement with the probable initial locations of settlements in the Norse and later medieval period illustrates that the two are remarkably consistent (Arge *et al* 2005). Evidence of farm abandonment is rare in the Faroe Islands, although in the 11th-12th centuries, a small number of what were probably inland shieling sites were abandoned (Mahler 1990, Edwards 2005). More recently, villages with poor coastal access that were probably initially settled because of good opportunities for growing barley have been abandoned. These have been relocated in areas with good coastal access, but would probably not have made good settlements in the Norse period because they receive little sunlight and would have been poor sites for barley cultivation. Therefore the limited abandonment that has taken place should be viewed not as a sign of "failure", but as an adaptation to a changing subsistence and economy. Nineteenth century abandonment is related to the declining importance of agriculture and the increasing importance of fishing, while in the 11th and 12th centuries, shieling abandonment may have represented an increase in trade from cattle to sheep rearing and wool production (Mahler 1998). Alternatively, the shieling areas became less important because there was sufficient biomass for the numbers of livestock likely to have been utilizing the rangeland area without the need for summer shielings (Thompson *et al* 2005). Apart from this limited abandonment, individual settlements are on the whole enduring in the Faroes. This signifies that Faroese villages were either well adapted to the topography and the needs of the villagers from early settlement, in which case there was no need to move anywhere else, or that because of the particular Faroe Island geography there was simply nowhere else suitable to relocate to.

A particular feature with respect to Faroese settlements is their arrangement in a nucleated cluster, which contrasts with the pattern of individual and often isolated farms in Iceland, Norway and Shetland. Primarily this has probably been a consequence of geography and topography, but interviews conducted for this research and historical sources also refer to a social function performed by nucleated settlements. It was necessary for people to live in relatively close contact because so many of the activities that were fundamental to Faroese subsistence required the labour of a minimum number of people. Fishing, fowling and the *grind* also required the use of boats, which were often collectively owned by a village and required at least 5 men to handle. The *grind* would, in particular, necessitate a fast mobilisation of a large number of people, several boats and quick and easy access to a harbour and bay. As the *grind* provided such a significant proportion of the islanders' diet,

particularly over the winter, it would have been crucial that people were quickly mobilised to take advantage of a *grind* opportunity.

Other resource utilisation strategies such as guillemot fowling, also required large numbers of people, e.g. a single fowler would be lowered by rope one or two hundred metres down the cliff, which would take 20 men or more to haul the fowler and his catch back up to safe ground (Nørrevang 1979). Another method of fowling was to ascend a cliff from below, requiring a party of between 4 and 12 men as well as enough hands to man a boat. As well as the *grind* and fowling, sheep gathering also took place communally.

How specific resource exploitation strategies may have limited human impact on the environment

As well as taking advantage of the surrounding topography, there is evidence that the Faroe Islanders efficiently utilised the wide variety of pseudo-infinite resources that were available to them, which would have supplemented their domestic produce or may even have provided the mainstay of their diet. In particular, an emphasis on pilot whales and fowling is apparent from emerging archaeological and ethnographic data.

The nature, methods and significance of fowling and egg collecting

Excavation at Undir Junkarinsfløtti on Sandoy uncovered a conspicuously large proportion of bird bones in three phases of archaeobotanical remains dated from the 9th to 13th century AD. This indicates a greater dependency on birds and for a longer period of time than any other of the Viking Age settlers of the North Atlantic (Church *et al* 2005). For example, although the use of bird resources also has parallels in southern Iceland (McGovern *et al* 2001), birds provided only a relatively minor supplement to the diet of Icelanders after the initial *landnám* period, whereas in the Faroes the hunting of birds for food has continued into the 19th century. Interviewees emphasised how birds have traditionally been used for their meat, eggs and feathers, particularly puffins and guillemots, and the use of these species back into the Norse period has been confirmed by the archaeobotanical evidence, with puffins and guillemots making up the greatest proportion of bird bones at the Undir Junkarinsfløtti site (Church *et al* 2005). The importance of birds as a resource is indicated by the archaeology and interviewees, and is also supported by the historical literature concerning fowling. Although the literature does not date back further than the 18th century, it is probable that rules designated for each village exist from much earlier. The presence of Manx shearwater and fledging puffin chick bones in the Norse period suggests the exploitation of nesting colonies, which is widespread in the Faroes today, indicating a

continuity of fowling practices. A brief account of traditional fowling methods and ownership, as known from at least the 18th century, is now considered.

The varied geography of the cliffs around the Faroes and the different bird species that nest there has produced diverse catching methods and access to fowling (Nørrevang 1979). The most important species for fowling from the Norse period to the modern period has probably been puffins, which are most commonly caught using the *fleyging* method, where the birds are caught one at a time while in flight, using long-handled nets. This process requires between 1-6 people depending on the ease of accessibility to the cliffs. Guillemots have also been an important species, although guillemot fowling requires a much larger party of people because they breed on high sheer cliff walls, so a fowler has to be lowered and raised by a rope. The right to fowl on cliffs is based upon land ownership and cliffs are clearly demarcated between villages, however, specific systems of ownership are different from village to village and on different islands. The first complete registration of fowling rights, documented in the *Taxationsprotocol*, an official taxation of land tenure dating from 1873, documents that in some villages, fowling was a right shared by all landowning people in the village. In others, including Sandur on Sandoy, fowling rights are allotted according to individual lots, based on lots owned in the *bøur* or infield (Nørrevang 1979). In St Kilda, an island community to the west of the Outer Hebrides of Scotland, where fowling played an important subsistence role, records from the 18th century state that cliffs were also divided according to the proportion of land each man had and were reallocated every three years along with the arable land (MacAulay 1764).

According to the *Taxationsprotocol*, a series of special rules and agreements secured the bird population against over-exploitation, which is supported by the interviewees who referred to several local regulations regarding fowling and egg collecting. It is notable that despite the small geographical area of the Faroes there are a variety of different fowling regulations, land tenure, fowling rights and sharing of the catch, suggesting each may have been adapted to the local community and conditions. It is not known how long regulations concerning fowling and egg collecting have been in place and who they were set and enforced by, although the *grannastevna*, a village annual legal gathering, may have played a key role (G. Bjarnarsson *pers. comm.*). The *grannastevna* was a form of village council that consisted of the *sýslumaður* (district officer) sitting with the owners of freehold land in a *bygd* to deal with matters of a local nature, e.g. deciding upon the division of pilot whales or how many sheep might be kept by a farmer. It is not known when the *grannastevna* was first established but it has probably been in existence for hundreds of years, possibly dating back as far as the 11th century. Rules and regulations concerning fowling are also likely to be long-standing and must have been in place long before the 19th century. It may be significant that despite the numerous traditional regulations and the respect that the villages held for

longer-established regulations (G. Bjarnarsson *pers. comm.*), there were no controls put in place to prevent the over-exploitation of birds as a result of more recent developments and advances in technology. For example, in the 19th and 20th centuries, significant reductions in the number of birds such as guillemots have been related to modern fowling methods such as shooting, for which no regulatory process existed until a few decades ago. The recent introduction of multiple nooses on boards floating in the sea, are neither subject to land ownership regulations. Similarly, whereas guillemot and puffin fowling was related to land ownership, fowling for fulmars is unconnected to landownership and the collection of fulmar eggs is unregulated. Fulmars have only been present in the Faroes since the 19th century and there were no established regulations in place governing their exploitation.

Regulations in the Faroes differed according to the method of fowling. For example, an informant commented that the *fleyging* method, which was used to catch puffins and could be carried out by a single person in good conditions, was unregulated. The *fygla* method, which involved holding a large net to the edge of the cliffs where guillemots were nesting, and which allowed a much larger number of birds to be caught at any one time, was only to be practiced every three or four years to allow time for bird populations to recover. Distinct regulations existed for villagers in Dalur in the south of Sandoy who had access to the cliffs of Skorin on the southern tip of Sandoy. In Dalur, the annual *grannastevna* agreed upon a quota of how many puffins (one informant gave this figure as around 32,000) could be caught and this was divided for each person according to their land ownership. Each person could fowl for as long as their quota remained unfilled.

Collection of bird eggs was also regulated. One example referred to in the interviews was that eggs (not specified of what species) could only be collected up until the 8th of June each year, as this gave the birds time to lay another egg. Other specific controls existed regarding guillemot eggs; although guillemots would come to the cliffs three times each year to lay eggs, it was stipulated that only eggs from the first laying could be collected and those from the second and third laying had to be left. This works on a similar principle of allowing the birds to lay an additional egg, indicating an awareness of the importance and sustainability of the resource. Another interviewee specified that puffin eggs could be taken from burrows but because they were so easily obtained, three years should be left to elapse before any more eggs were taken from that burrow. Other customs are that puffins are taken in burrows early in the season when a mate can be replaced, while during the breeding season, any bird carrying fish is spared (Harman 1997). The plethora of regulations surrounding fowling suggests that the Faroese were careful to conserve the bird colonies that they relied on.

Regulations against the over-exploitation of sea birds and eggs appears to have been adapted to the breeding patterns and number and vulnerability of different bird species, and

also appear to have varied in different villages, which may support the idea that regulations were enforced locally. On the islands of St Kilda and Sula Sgeir off the northwest of Scotland, fowling procedures were also controlled by communal action (Serjeantson 2001). In St Kilda the inhabitants themselves acted to police the cliffs if strangers attempted to disturb the birds or to steal birds or eggs (Baldwin 1974, Harman 1997). There is evidence for similar contemporary community or village based measures elsewhere that have been successful in managing natural resources. For example, in the Oceanic island of Vanuatu, Johannes (1998) surveyed 26 villages and found that all but one village had village-based marine resource management measures, and that no village had exactly the same set as any other. The purpose of the village-based regulations in Vanuatu enabled a measure of flexibility and diversity, which allowed for effective adaptation to changes in the availability of the marine resources (Berkes and Folke 2002). It is possible that in a similar respect, a community or village-based approach to the regulation of sea bird and egg exploitation allowed for flexibility and proved beneficial to the success of long-term settlement in the Faroe Islands.

Seabird fowling is by no means unique to the Faroes and seabirds played an important role in the subsistence strategy of other North Atlantic island settlements for example, the Isle of Man (Fisher 1997), the Westmann Islands to the south of Iceland, St Kilda and Orkney. Seabirds have also been used for trade which persisted in Orkney (Fenton 1978) and the Hebrides (Baldwin 1974) into the 20th century, while in St Kilda the economy was almost entirely based on cliff-nesting birds (Serjeantson 2001). Seabird fowling was also important in other maritime and island communities, such as the Canary Islands where wild birds continued to be eaten into historical times, and at sites in Patagonia where wild birds were found to be a major source of food (Serjeantson 1997). In oceanic island communities in the southwest Pacific, fowling for marine birds also formed a prominent part of historical and traditional food procurement strategies (Anderson 1996). Particularly in islands in the southwest Pacific, seabirds declined massively in numbers with the colonisation of people. For example, on Henderson Island in the Pitcairn Island group, seabirds were overexploited to the extent that led one researcher to attribute abandonment of the island to the depletion of seabirds and pigeons which may have been the only food source (Steadman and Olson 1985). Over-exploitation of seabirds is also known from closer to the study site, for example in the case of the great auk, a North Atlantic flightless bird which failed to survive human predation and became extinct in 1844. Although its biology played a significant role in its decline, the lack of human management was also a factor “because the breeding colonies were not subject to controls either arrived at voluntarily or imposed by the state” (Serjeantson 2001: 54). The failure of prehistoric farming communities to evolve adequate voluntary control over an unfamiliar resource contributed to the decline of the great auk around the shores of the British Isles. According to the available evidence, it is suggested

that in the Faroes (at least prior to the advent of modern fowling methods), fowling was managed carefully enough to prevent a catastrophic decline in numbers and this has ensured the continuity of fowling practices to the present day.

The nature, methods and significance of the grind (pilot whale drive)

Interview respondents particularly stressed the importance of the *grind* for supplying not just meat and blubber for food, but blubber for oil, bones for fertiliser and boiled down whale meat as winter feed for cattle, especially after a poor hay harvest (Annandale 1905). Whale meat was particularly important to non-land owning individuals because the catch was distributed among the whole village, including those widowed or impoverished, not only the shore-owner and those participating in the hunt (Joensen 1976). It is probable that a form of pilot whaling has taken place for several centuries, even back to the time of early settlement (Joensen 1976, Gjessing 1955, Brøgger 1937), although the *grind* is not mentioned in historical records until 1592, with the first information about a slaughtered *grind* appearing in 1600 (Bjørk 1963). Whether the Faroese whale hunt began with the first settlements has been debated (Gjessing 1955, Høst 1875). Few whale bones were present in the early archaeological phases at Undir Junkarinsfløtti, but this does not signify that whales weren't being utilised then. Whale bone may have been disposed of away from the farm middens or it may have been used in other ways, such for fertiliser, as artefacts, in specific architectural contexts or even as fuel utility as there is evidence that fresh cetacean bone was used as an alternative to peat until the beginning of the 20th century (Clark 1947).

There are written records throughout Atlantic Europe for the historic period indicating that whales were highly prized and thoroughly used wherever they could be obtained (Gardiner 1997, Jenkins 1921, Evans 1996, Mulville 2002). The earliest reference to the utilisation of sea mammals come from Bede writing in 731 AD. Records also state that porpoises were caught off the coast of Ireland in c.827 AD by "foreigners" who may have been Vikings (Gardiner 1997). Similarities to the techniques and technology used in the Faroese pilot whale drive can also be found in other geographically widespread island communities, both modern and prehistoric. In a recent example in the Solomon Islands, north of New Guinea in the Coral Sea, dolphins are driven by hunters who utilise an armada of dugout canoes to locate and surround an incoming dolphin herd. The hunters then knock together 15 cm cobbles to disorientate the dolphins and force them into narrow passages where they can be captured by villagers, hauled into canoes, killed on shore and taken back to the villages (Takekawa 1996, Porcasi and Fujita 2000). This is similar to the traditional technique used for driving pilot whales in the Faroes whereby the whales were headed off from the open sea by boats, herded into a chosen inlet and driven ashore sometimes aided by dropping stones and beating the sides of the boat (Debes 1676). In late prehistoric Easter Island, dugout

canoes were also used for dolphin hunting, and large quantities of dolphin bone were found at archaeological sites up until 500 years ago when the island became completely deforested and dugout canoes could no longer be manufactured (Steadman *et al* 1994). In local coastal communities in the Western Isles, Shetland and Orkney, small pilot whale drives have persisted for centuries although these ceased in the latter half of the 20th century (Evans 1996, Mulville 2002). In Iceland, whale strandings are frequently mentioned in early historical sources, but lesser so organised hunts. In the Shetland Islands, pilot whales were driven into bays much in the same way as a *grind* is carried out in the Faroes, but the whales were utilised principally for their blubber which was rendered to oil and sold. The meat was almost always never eaten (Shetland Islands Museum 2007). In conclusion, although there is a tradition of whale hunting across the North Atlantic region, whales appear to have been utilised differently in the Faroes where pilot whales provided a considerable, perhaps even the most important, proportion of the Faroese diet.

Conclusions: why might human impact in the Faroes have been limited?

In summary, there are several reasons why human impact in the Faroes might have been limited. The natural pre-colonisation characteristics of the Faroe Islands were insensitive to impact, dynamic elements of the landscape were already established prior to colonisation, and the extent to which people themselves acted by adapting to the local environment and utilising resources minimised environment impact. Erosion caused by overgrazing may, in particular, have been lessened by a reduced emphasis on animal husbandry and the diversification of subsistence strategies, including the exploitation of pseudo-infinite resources such as seabirds and pilot whales.

It is however difficult to identify the extent to which natural factors on the one hand, and cultural adaptation on the other played a role. This will be assessed in chapter 8 by comparing trajectories of natural and cultural change in the Faroes with those of Iceland and Greenland, also colonised by the Norse. These three islands were consecutively settled by a relatively well-known Norse population, whose experience was based on west Norwegian subsistence farming, but to what extent did cultural trajectories vary after initial settlement, and to what extent did the different landscapes and climate of the islands play a role?

Chapter summary

This chapter has established an outline of late Holocene landscape development in the southern Faroe Islands, providing a baseline from which the extent of later human impact in the Faroe Islands can be calculated. Two significant environmental thresholds are apparent in Faroese environmental records and although the earlier threshold change can be

attributed to natural factors, there is no unambiguous evidence to suggest that the second threshold was a result of climatic deterioration or early settlement, i.e. earlier than attested to by existing archaeological and palaeoenvironmental research. Either way, landscape change prior to settlement of the Faroes appears to have desensitised the environment to consequent change and the significance of long-term human impact in the Faroes is apparently limited. To conclude, this chapter assessed why human impact in the Faroes might have been limited by natural factors such as the trajectory of the pre-colonisation landscape and ecology, and cultural factors such as a diversification of subsistence strategies and the importance of communal activities.

The following chapter compares the conclusions of the site-specific research in Suðuroy and Sandoy to original and secondary data from Iceland and Greenland, in order to assess the similarities and contrasts between outcomes of human settlement in the Faroes, Iceland and Greenland.