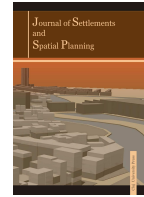




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Interplays of Site and Situation along Tunulliarfik Fjord, South Greenland

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ABSTRACT

Site and situation are dynamic factors in the origin, success, demise, and adjustments of human settlements. Over a period of 3500 years, human settlement in the environs of Tunulliarfik Fjord in southwest Greenland has undergone a number of changes brought about by the interplays of site and situation. While climate variability over time is at the forefront of most discussions on the human history and geography of Greenland, it is more appropriate to examine the interactions between climate, ecosystem, resource usage, and extrinsic influences in presenting a regional study of settlement over time. Through field work and literature review, these interactions were examined and analyzed from the early Saqqaq and Dorset cultures through the Norse colonization and up to the present time. Climatic shifts appear to be influential in the rise, adjustment, and demise of settlements along the fjord, but extrinsic factors and events have also played important roles, especially in the case of the Norse era, the economy of Narsaq, and in the founding of Narsarsuaq.

1. INTRODUCTION

Residents along Tunulliarfik Fjord in South Greenland sometimes refer to the region as *Sineriak Banaaneqarfik* or the “banana coast” [1]. In 982 A.D. when Viking Erik the Red (Erik Porvaldsson) sailed up the fjord, he knew nothing of bananas, but evidently saw the potential that parts of the coastal zone presented for successful settlement. A few years later the intrepid Viking again landed in the fjord, this time with 14 ships bringing about 300 colonists and a number of dairy cattle and sheep [2]. The colony he founded lasted for some 500 years until situation changed.

Erik and his tribe were not the first humans to see the prospects this region offered and they were not the last to exploit its site characteristics. Arctic Small Tool Tradition peoples of the Saqqaq and Greenlandic Dorset (hereafter referred to as Dorset) cultures were

here first [3], [4] [correspondence with personnel at the Narsaq Museum, June and August, 2014]. The term “*small tool tradition*” is derived from the finely-flaked, tiny lithic knives and harpoon tips that these peoples utilized. These early cultures are generally referred to in the literature as Palaeo-Inuit or Palaeo-Eskimo, but recent findings based on DNA analysis have determined that the Saqqaq and Dorset are more closely akin to Siberian cultures and are not the ancestors of modern Inuit [5], [6]. A few centuries after the demise of the original Norse settlement, new immigrants from Scandinavia and Iceland came to fish and farm. During the Second World War, the United States military constructed an air base along the fjord at Narsarsuaq. Ancient Arctic Small Tool Tradition people, Vikings, the Thule people, modern Scandinavian, modern Inuit, and the U.S. military have all taken advantage of the region’s site characteristics. Over time, activities were transformed and cultures departed or made

adjustments as local, regional, and global situations changed. A developing tourism industry along the fjord, the specter of climatic warming, and recent discussions regarding the mining of rare earths in the region all present the prospect of further situational adjustments. The purpose of this paper is to illustrate some of the ways in which the interplay of site and situation, real and perceived, at various times may have shaped settlement and economic activity along Tunulliarfik Fjord.

2. THEORY AND METHODOLOGY

Site is the actual location of a settlement and is composed of the physical features of that location [7]. A few examples of natural site characteristics are climate, proximity to a navigable body of water, soil fertility, local flora and fauna, landforms, and relief. Human-built features such as airports and canals can also be considered site characteristics. Situation is more complex. Some of the circumstances that may be considered situational factors are: 1) the location of a place within a broader regional or global framework; 2) relative location; 3) natural or human-caused disasters, and 4) economic and/or social changes. Once a settlement has been established, situation advantages (and disadvantages) can take on a site aspect [8].

Whittlesey wrote that humankind's sense of place varies over time and place [9]. A particular culture group's sense of place develops not simply because of the economic possibilities and limitations presented by the natural setting, but also because of the group's perception of the land. The initial motive for creating a settlement tends to arise from perception of the site characteristics, but it is often situation that leads to expansion, regression, demise, or change of the settlement over time. While climate variability over time is at the forefront of most discussions on the human history and geography of Greenland, it is more appropriate to examine the interactions between climate, ecosystem, resource usage, and extrinsic influences in presenting a regional study because these phenomena and activities do not exist in a vacuum. Human occupancy of a place results from both the influences of the local natural environment and the human decisions based on the perception of that environment.

An extensive literature review of books and papers on the settlement history of Greenland was conducted to ascertain how the region of Tunulliarfik Fjord evolved in a different manner than other locations on the island. Once this was established, a theoretical framework was developed by examining some of what had been written regarding the components of site and situation. In order to integrate theory and the reality of Tunulliarfik Fjord, the author undertook field work in the region during June, 2014. Field work consisted of

several guided excursions with Arctic Adventure (a Danish company providing personal guides and excursions in Greenland) and independent explorations of the settlements and their environs. A series of casual interviews were conducted with local residents to gain insight into their perceptions of the region's geography, history, and sociology. Upon returning home the author continued correspondence with several current and former residents and continued to monitor news reports from the region. Then commenced the fashioning of a descriptive analysis of the region.

3. RESULTS AND DISCUSSION

3.1. General site characteristics of the region

Tunulliarfik Fjord (formerly Eiriksfjord) is located in southwest Greenland about 175 km north of Kap Farvel, the southernmost tip of the island (fig. 1).



Fig. 1. Greenland.

The fjord is oriented NE-SW. The airport at Narsarsuaq near the head of the fjord is at latitude 61° 09'N, longitude 45° 26'W. The region discussed in this paper extends southwestward approximately 60 km from near the head of the fjord to the vicinity of Narsaq where the fjord becomes Narlunaq Skovfjord (see fig. 2).

Average width of the fjord is 3.6 km with the widest point being approximately 8 km from shore to shore and the narrowest point being about 1.7 km. Water depth in the northern reaches of the fjord averages 40 m, 100-150 m near Narsarsuaq, and near Narsaq there are sections that exceed 300 m.

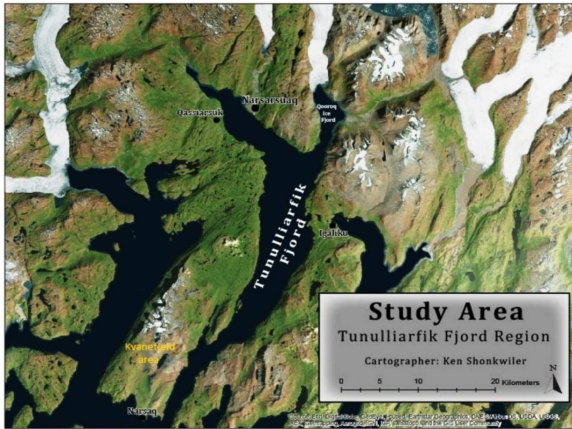


Fig. 2. Detailed map of Tunulliarfik Fjord Region.

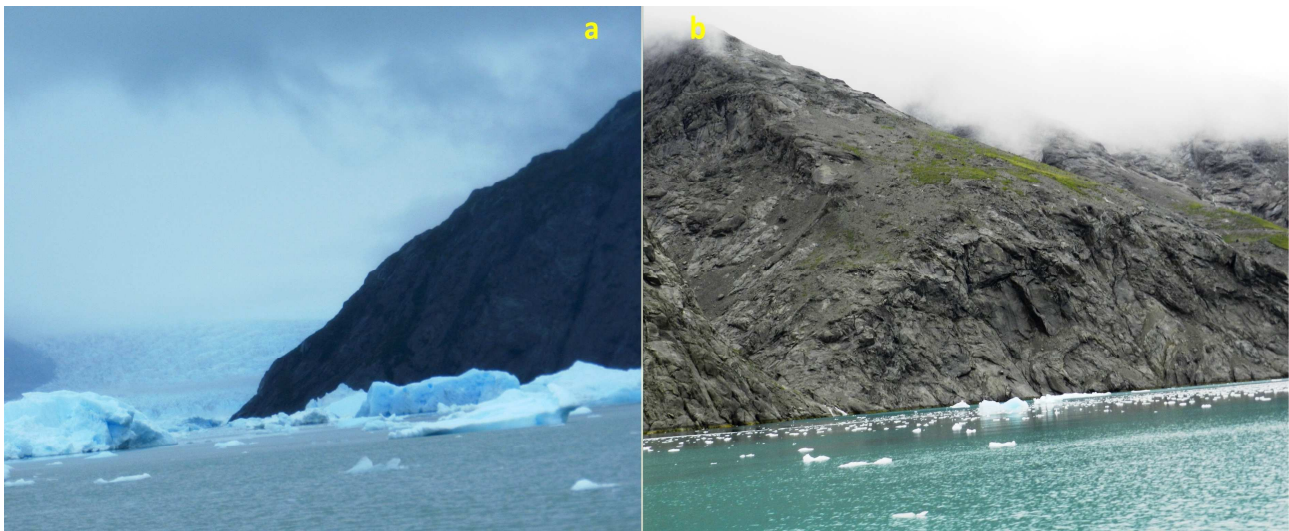


Fig. 3. a). Qooqqup Sermia; b). There is little level land on the shores of the Qooroq Icefjord.

Physiography of the fjord area is dominated by rugged mountains composed largely of pre-Cambrian igneous and metamorphic rock. The highest elevations in the study area are in the range of 1200-1400 m. There are, however, extensive areas of lowlands along parts of the coast. The toponyms “Narsaq” and “Narsarsuaq” refer to “plain” in Kalaallisut (the Greenlandic language). Abutting some of the coastal lowlands are rolling uplands with elevations between 100 and 500 m ASL.

Although much of the length of Tunulliarfik Fjord is less than 50 km from the edge of the inland ice, the climate is relatively mild.

Narsarsuaq records a January mean temperature of -8.6°C and has a July mean of 12.8°C [10]. The southwestern edge of the fjord is a degree or two warmer in winter and a few degrees cooler in summer due to a maritime effect. Average annual precipitation is 61.5 cm. In the widely-used Köppen-Geiger system of classification this is a Dfc climate, boreal subarctic with no dry season. Despite its proximity to the inland ice, there is virtually no permafrost except at the ice margin.

Icebergs calved from Qooqqup Sermia (fig. 3), an outlet of the inland ice, move through the Qooroq/Qooqqut Icefjord (an arm of Tunulliarfik Fjord) and then float down Tunulliarfik year-around. There is a submerged moraine at the mouth of the icefjord and many bergs run aground there. Land-fast sea ice may temporarily develop in the inner part of the fjord in winter, but the extent and duration is quite variable. Marine life is quite plentiful with arctic char, cod, capelin, and halibut being the most common fish. Greenland sharks are occasional visitors in the depths and salmon are also known to enter the fjord [correspondence with Ole Guldager of the Narsarsuaq Museum, August 2014]. Common marine mammals are ringed seals and minke whales, both of which are hunted under limited quotas. Orcas visit on occasion.

Soils in the region are thin with limited horizon development and meager nutrient content. Therefore most types would be classified as entisols or spodosols. Vegetative cover in some places is quite lush; however, the region is species-poor. The total number of vascular plant species in South Greenland as a whole has been estimated to be 309 [11]. Conifers, with the exception of creeping juniper, are absent. Dwarfed mountain birch occurs sporadically, but the most common groundcover in the region consists of various shrub willow [12]. Some low places exhibit lichen-rich dry grassland and at Narsarsuaq and Qassarsuk some coastal salt marsh is found. Higher elevations and craggy cliff sides exhibit discontinuous vegetation. Only two terrestrial mammal species, the arctic fox and arctic hare, presently abide in the region. At times in the past 200 years small numbers of reindeer were intermittently present in the region [source: interviews with local residents] and there is evidence that people in the Norse Eastern Settlement consumed reindeer [13] but it cannot be said with any certainty if the animals were local. It has been reported that the last reindeer in the region were hunted to extinction by the

Inuit [3]. Today the nearest wild and feral herds are found 340 km north near Qeqertarsuaatsiaat [14].

There are four settlements of some significance in the study area. Narsaq (2013 population 1503) is located at end of the Narsaq Peninsula where Tunulliarfik Fjord meets Narsap Ikerasaa. Channel depth of the harbor is 23 m and vessels of up to 150 m can be accommodated. The settlement of Narsarsuaq (2010 population 158) is located on a glacial outwash plain on the east side of Tunulliarfik on a triangularly-shaped peninsula between the main fjord and its Qooroq Icefjord arm. The settlement is the site of South Greenland's airport. Almost directly across the fjord from Narsarsuaq on the west bank is Qassiarsuk (2010 population 40; 89, if including neighboring sheep farms), on the site of Brattahlíð, the estate of Erik the Red. It is predominantly a sheep farming settlement. Igaliku (2014 population 29; 55, if including nearby farms) is a sheep farming village south of Narsarsuaq at the head of Igalikup Kangerlua. Igaliku was the site of the Norse bishopric from the 12th to the 15th Centuries. A glacial col provides overland access to the eastern shore of Tunulliarfik Fjord.

There are a few roads in the study area. Those that exist are mainly within the settlements or those which connect a settlement with a dock or former military installation and others which provide access between sheep farms. While it is possible to travel overland from Narsarsuaq to Qassiarsuk by fording the Narsarsuaq River, the journey is made difficult due to its swift current, deposits of silty quicksand, and annual flooding in that meltwater stream. There is regular helicopter service between Narsarsuaq and Narsaq, but most travel between the settlements is done by watercraft.

The physical site characteristics presented above, are, of course those of the present age. It can reasonably be assumed that landforms and geology have changed only slightly over the course of several thousand years of discontinuous human habitation in the region. The factor that has not been constant is climate which has fluctuated between cooler and warmer periods. Flora and fauna would have been altered with climatic shifts. It does seem, however, that the arrival in the region of the Palaeo-Inuit groups and the Norse all occurred in periods of relative warmth similar to the present-day climate of South Greenland [15].

3.2. Site and situation in the past

Saqqaq and Dorset. Archaeological investigations have determined that at least two Arctic Small Tool Tradition cultures habituated the environs of Tunulliarfik Fjord [3], [16], [17]. It must be kept in mind that the little evidence of Saqqaq and Dorset in South Greenland makes suggestions of the early demography of the area “scholarly guesses based on projections of data from

neighboring regions” [correspondence with J. F. Jensen, September, 2014].

The Saqqaq arrived in Greenland around 2500 B.C. and disappear from the archaeological record 900-800 B.C. The Saqqaq people generally located their settlements at the mouths of valleys that led inland. Earliest Saqqaq settlement was around Disko Bay, but in time they established settlements southward along Greenland's west coast. The early Saqqaq period around Disko Bay was a time of warmer sea surface temperatures, but the later years were likely a time of unstable climate which culminated in a period of continuous cold conditions which began around 1500 B.C. [4]. From this it may be inferred that the appearance of the Saqqaq in Tunulliarfik Fjord 1500-1000 B.C. was a response to deteriorating climate in their northern settlements. Figure 4 shows a site at Qassiarsuk where Saqqaq artifacts have been unearthed. Evidence of Saqqaq settlement may have also been found on Nuummiut Promontory near Narsaq [17]. This site on a small cape at the corner of Sermiuk Fjord and Narsap Ikerasaa was a place with easy access to seal hunting and fishing. Reindeer were in the vicinity. There are several meltwater streams nearby which would have provided fresh drinking water and wild berries would abound in the valleys during the summer. Many Saqqaq sites exhibit such a broad-based all season resource pattern [18].



Fig. 4. Partially restored Inuit earth dwelling at Qassiarsuk. It dates back to around 1700 A.D. Artifacts uncovered in older middens below suggest that the Saqqaq settled here 1500-1000 B.C.

The exact reasons for the disappearance of the Saqqaq around 900-800 B.C. are unknown, but two scenarios are plausible. First, temperature reconstructions in west Greenland show a marked cooling beginning around 800 B.C. and lasting over 800 years [15]. The Saqqaq, with their hunting and fishing technologies may not have been able to adapt. For example, they preferred open-water hunting of seals [19] and colder temperatures with greater sea ice coverage would have curtailed that activity. Secondly, there is the arrival of the Dorset culture at roughly the

same time. The Dorset, originally from Canada, had first migrated to Greenland's northwest coast and by the late Saqqaq period were moving south. Dorset technologies such as snow knives, sledge shoes, and soapstone vessels for burning seal fat, were better-suited to the now colder climate [4], [20]. There appears to be some chronological overlap between the Saqqaq and the Dorset. Perhaps the former altered aspects of their material culture to reflect what they observed of the Dorset and in time became indistinct from the newcomers. Most Dorset sites are found at the same localities where the Saqqaq people had settled [21], an indication that both cultures valued similar resources and physical site characteristics.

The Dorset people were quite adept at hunting from the sea ice [22], but by 100-200 A.D., the climatic situation was again changing. Moros et al. implied that warm sea-surface temperatures and limited sea ice around Disko Bay around that time may have impacted Dorset activity [23]. It can be assumed that further south in Tunulliarfik Fjord the climatic shift may have been greater and the Dorset evacuated the region seeking cooler waters further north. However, there is no archaeological confirmation for such a northward migration [15]. The vanishing of the Dorset from South Greenland remains a mystery. Perhaps, because of their small populations, 20 or 30 persons in a settlement, and their isolation, Dorset settlements around Tunulliarfik Fjord succumbed to disease or deprivation. With the Dorset gone, the environs of Tunulliarfik Fjord remained uninhabited until the arrival of the Norsemen (inferred from [4], [24], [25]).

The Norse Eastern Settlement. Erik the Red and the Norse arrived in Greenland as the Medieval Climatic Optimum, commonly called the Medieval Warm Period, was getting underway. This epoch of relatively mild climatic conditions in Europe and the North Atlantic is generally believed to have lasted roughly 900-1300 A.D. The warming was not totally uniform and there were spatial and temporal temperature fluctuations during the epoch [26].

As Erik sailed up the fjords in southwest Greenland, he soon realized the potential that parts of the physical landscape presented for animal husbandry, hunting, and fishing. Two far-ranging settlements eventually emerged, the Western located along a series of fjords which met the Atlantic near present-day Nuuk and the Eastern along Tunulliarfik Fjord. At both locations the overall landscape was not too different from the place he left in Iceland, but, upon closer inspection this was a better land. For instance, there were no sterile lava flows and there was the possibility of having larger hayfields. Willow scrub could be used for fodder and fuel and here and there were sizeable groves of birch [24]. Lyme-grass (*Elymus arenarius*), a resource Erik was probably familiar with, grew wild in a number of places along the fjords. This versatile plant

was used in Iceland as a human food source, especially if cultivated barley crops failed [27]. It was also used for grazing sheep and cattle and could be cut for fodder. The stalks could be used for thatching and insulation material. The rhizomes and roots were used to make felt-saddles and ropes [28]. Along Tunulliarfik Fjord, Erik espied large swatches of verdant land and looked for possible landing sites that might serve an agricultural settlement well. One of these places was in the inner fjord at present-day Qassiarsuk where by convention it is thought he established his estate Brattahlíð (fig. 5). An alternative hypothesis is that Brattahlíð was situated at Qinnua near the head of Tunulliarfik Fjord, a short distance north of present-day Narsarsuaq [29] however, a study of that site using pollen analysis, landscape history, and examination of settlement structure concludes that it *"was probably not at Qinnua"* [30].



Fig. 5. Qassiarsuk. This site would have appealed to Erik the Red for several reasons: 1). A long stretch of beach for setting up quays. 2). A goodly amount of relatively level land; 3). No volcanically-derived landforms or soils. 4). Lyme-grass growing near the shore.

Because of a longer growing season and its location relative to the sea lanes between Iceland and Greenland, the Eastern Settlement had perhaps as many as 4,000 people at its height while about 1,000 may have resided in the Western Settlement. By the middle of the 13th Century the Eastern Settlement had 400 or 500 homesteads/farms [31], [32]. The population was supported by subsistence farming, fishing, hunting in the hinterland, and trade with Iceland and Europe. The Norse improved upon their farming by harnessing snowmelt and glacial meltwater for irrigation. Remnants of their irrigation engineering have been found at Igaliku/Gardar [32]. Irrigation was a response to times when relatively warm winters lengthened the growing season, but rainfall in the extended season was scanty [33]. Seasonal hunting took place in the Norursetur (*"Northern places"*) 800 km away around Disko Bay. At Norursetur the Norse obtained walrus skin and ivory, narwhal tusks, polar bear skin, and gyrfalcons. The yearly expeditions were

essential for augmenting the economy of the Eastern and Western Settlements by providing commodities for trade with Iceland and Europe [34].

The Eastern Settlement lasted into the 15th Century; the last recorded event was a wedding which took place in September 1408 at Hvalsey Church near present-day Qaqortoq [34], [35]. That record discloses that there were many people in the church that day, suggesting that the settlement was still viable at that time. Carbon-dating of clothing found in graves indicates the Norse were still here around 1430 A.D. [35], but by the end of the century the Norse are gone. Changes in situation, internal and external, appear to have brought about the end of the Norse in Greenland. The popular perception is that deteriorating climate and maladaptation to the changes brought on by cooling led to the demise, but the research suggests a multifactorial web of causation [24], [36], [37].

The Greenlandic Norse lived precariously close to deprivation even when meteorological conditions were ideal [38]. It would not have taken but a few seasons of inclement weather to upset their dairying, fishing, and hunting. Analysis of ice-core samples from 1343 to 1362 shows that summers during that period were colder than those typical of previous years [38]. D'Andrea et al. [15] demonstrated an abrupt cooling trend in West Greenland in roughly the same time frame. The Little Ice Age had begun and changing sea ice conditions would make travel and communication with Iceland and Norway more arduous and less frequent. Concurrently, the involvement of Norway with the Hanseatic League reduced Greenland to an "economic afterthought" [37]. The European trade network was expanding and certain commodities from Greenland such as walrus ivory, narwhal tusks, and furs were being replaced by more easily accessed elephant ivory from Africa and Asia and furs from Russia [37]. The decline of trade and travel would have impacted a population that was somewhat reliant on outside subsidy. Mikkelsen, et al. suggest that sea-level changes may have also contributed to the demise of the Norse. A drowning of coastal lands along Igaliku Fjord has been documented and earlier studies suggest that the fertile lowland at Brattahlíð/Qassiarsuk stretched more than 100m into the fjord relative to the shore today. The rise in sea level appears to have exceeded one meter [39]. Ironically, marine transgressions are often associated with a warming trend, but this incursion of the sea was due to crustal down-warping caused by an advance of the Inland Ice as the climate cooled.

Soils along Tunulliarfik Fjord are generally thin and overgrazing could have led to soil erosion problems which in tandem with a shorter and perhaps wetter growing season would have negatively impacted hay crops. While it does not seem that the Norse adopted any Inuit technologies or methods for hunting and fishing, the dietary evidence from the latter days of

the settlement shows their diet became dependent on fish and seals sourced from the fjord and this puts doubt on the maladaptation hypothesis [13]. However, it is conceivable that the Norse had an identity crisis as well. They thought themselves to be farmers and ranchers, not fishermen and hunters. Stockinger proposes that "Their social status depended on the land and livestock they owned, but it was precisely these things that could no longer help them produce what they needed to survive" [40]. Relations between the Thule (Inuit who arrive in the area around 1200-1300 A.D.) and the Norse were not generally hostile and there is archaeological evidence of barter and trade [24]. There is speculation based on archaeological investigation that Norse and Thule co-existed at Sandhavn [41]. Sandhavn was located on a sheltered bay on the south coast of Greenland, approximately 5 km west-northwest of the site of Herjolfsnes and within the area of the Eastern Settlement. The entrance to the bay is narrow and there was a wide sandy beach bordering the harbor. Such site characteristics would have been ideal for a trading station. While there may have occasions of conflict, there is no evidence that Thule raids played any serious role in the demise of the settlement [42].

It is conceivable that as economic conditions deteriorated the birthrate would have declined and some residents would have returned to Iceland or Norway [43]. The archaeological evidence suggests an orderly withdrawal from the Eastern Settlement [40]. Berglund notes that, apart from broken pieces of church bells, no sacramental objects such as chalices or candlesticks have been found in the church ruins. "Such objects should be found in churches suddenly abandoned" [44]. Because of the reasons outlined above, the settlement may have been abandoned when the population had become too small and conditions too difficult. The last residents may have attempted to sail to Vinland or Iceland and disappeared.

The Thule (Proto-Inuits). The Thule people were the ancestors of all modern Inuit. These proto-Inuit originated in Siberia, expanded into coastal Alaska, and by 1000 A.D. had moved eastward across Canada. Bands of Thule reached Greenland by the 13th Century. The commonly accepted explanation had been that the warming of the climate during the Medieval Warm Period led to a reduction of sea ice which may have increased bowhead whale populations [45], [46]. This whale was the main sea-mammal prey of this maritime hunting culture and bands of Thule may have followed the resource to the eastern Arctic. More recent investigation, however, contends that the search for iron led the Thule to northwest Greenland for meteoric iron that would be fashioned into harpoons and other implements [47]. Dog-drawn sleds along with skin boats made the Thule quite mobile, allowing them to travel rapidly over large distances and McGhee [48]

suggests that they managed to travel almost directly from Alaska to Greenland within a few summers. Ken MacRury, an expert on Inuit dog history comments that, *“The dog would have been invaluable in the rapid travel if McGhee’s theory is correct. The dog for spring travel and the umiak/qayaq for summer travel would have allowed the Thule people to cover the distance in a few years, even given that they would have been traveling as family units with women and children”* [49]. First landing in northwest Greenland near Cape York (approximately 76 °N), the Thule eventually made their way south along the coast and arrived in the Tunulliarfik Fjord region in the 1300s. Their relics are often found in the same locations, for example at Nuummiut near Narsaq, as those of the previous Saqqaq culture [17]. The movement south may have coincided with cooling temperatures [50]. The Thule were well-suited for subsistence in a cooling environment and were quite versatile. In South Greenland with more open water, seal-hunting from kayaks became more significant than whaling and as the climate cooled, killing seals at breathing holes in the ice increases in importance as well [51]. The Thule interacted with the physical environment through hunting, fishing, and gathering and this influenced settlement locations [52]. The impact of climatic shift is seen in the fact that earliest settlements were near the western coastline, but later winter settlements were located at the ice-covered inner fjords. A number of Thule winter house ruins and even some summer tent rings have been discovered on the south shore of Tunulliarfik Fjord a few kilometers east of Igaliku [16]. The Thule settled here after the Norse had abandoned Gardar (Igaliku) as evidenced by their re-use of stones from Norse stables, outhouses, and other structures.

Unlike the Saqqaq and Dorset cultures which disappeared, the Thule transformed. Friesen surmises that changes in settlement location, architecture, and artifact form began incrementally circa 1400 A.D. [52]. In South Greenland house type changed from small single-family stone and turf huts to large communal dwellings. There was a greater dependence upon seals and fish and less emphasis on large sea mammals. These alterations in Thule subsistence and settlement patterns correspond with the Little Ice Age. More frequent contact with Europeans in the late 17th and early 18th Centuries exposed the Thule to new resources and ideas, although the degree of impact would have varied by location. The Thule who had always been versatile and adaptable made local and regional socio-cultural adjustments and became the Inuit.

3.3. Site and situation in the Modern Era

Following the collapse of the Norse Eastern Settlement, expeditions from England and Norway sporadically landed in Greenland from the late 16th to

the early 18th Centuries. European whalers also made landfall, but no permanent settlements were established until 1721 when Lutheran missionary Hans Egede from the joint kingdom of Denmark-Norway landed near present-day Nuuk in an attempt to bring the Reformation to the “lost” Norse of Greenland. Not finding his countrymen, Egede set out to Christianize the Inuit and set up a trading settlement with the support of the Bergen Company. He also found his way to the Narsaq Peninsula along Tunulliarfik Fjord [17]. Shortly after, Denmark-Norway proceeded to establish trading colonies at a number of sites along the coast.

Narsaq. The town of Narsaq (1,503 population in 2013) located at the westernmost end of a large peninsula between Tunulliarfik Fjord and Sermilik Fjord began as Nordproven (“North Test”) in the year 1830. A deep-water harbor (fig. 6) and plentiful seals were the motivational site characteristics.



Fig. 6. Narsaq. Part of the original Nordproven harbor area. *The white building on the left is one of the oldest buildings in Narsaq It was a “spækhuset” (blubber house), a warehouse involved in the seal and whale trade.*

Local seal hunters traded blubber and seal skin for European goods. The seal trade formed the basis of Narsaq’s economy, but by 1900 the seal business began to wane. Historical records show that ringed seal skins traded at Qaqortoq (formerly Julianhab), 25 kilometers east of Narsaq, declined dramatically after 1900 [53]. The decline in the seal trade in South Greenland may have occurred through a combination of climate and increased technology. The period 1860-1910 saw an unstable and wetter climatic that may have negatively impacted fast ice conditions. Ringed seals need ample snow cover to build their birth lairs on the fast ice and stable ice conditions for raising their pups. Below optimum ice could have reduced the seal population. In terms of technology, there is an inverse correlation between ringed seal skins traded annually in Greenland and the number of shotguns and rifles sold to Greenlandic hunters [53]. Compounding the climate and technology factors was a contraction of the market for seal products [54]. The little that remained of Narsaq’s commercial sealing heritage disappeared

finally in 2007 with the closure of Eskimo Pels, Ltd., a small private company that produced hand-sewn sealskin items (Source, interviews with local business people).

In Narsaq the main basis for the economy began to shift to fishing. Sea temperatures began to increase markedly around 1917 and Atlantic cod were increasing in number and spawning off the coast of South Greenland [54], [55]. The human population also increased from 162 in 1919 to 300 in 1930. However the town did not experience major population growth until 1953 when Royal Greenland opened a shrimp and fish processing plant. By 1959 the population exceeded 600. The Danish government encouraged the fisheries by investing in a number of large trawlers (eventually transferred to the private sector) and providing loans and educational assistance.

The cod era was not to last, however, as overfishing depleted stocks in the post World War II era and cooling sea temperatures in the late 1960s disrupted spawning. By the 1990s when waters were once again warming, the cod were all but gone [55].

Situation changed in Narsaq with each climatic fluctuation. The cooling waters brought in more northern shrimp (*Pandalus borealis*) to Tunulliarfik and other southern fjords and the period 1970-1990 saw an expansion in shrimp fisheries in West Greenland. In the 21st Century, the climatic pendulum swung again and the waters around Narsaq warmed. The shrimp factory closed in 2010 after the prawns headed north to cooler water. Commercial fishery collapsed. There had been eight commercial fishing vessels stationed in the town, but today only one operates [56]. The only option for fisherman who had been selling their catch to the factory is a small local market (fig. 7). In fact, local people commented that fishery along the entire length of Tunulliarfik Fjord has dramatically fallen (fig. 8).



Fig. 7. The local fish market at Narsaq.

In this area where sea life once dominated the economic scene, there was a return to the old Norse way of life due to warming conditions and essentially the same land-based site characteristics that enticed Erik the Red. The Royal Greenland shrimp factory was transformed into Neqi, a sheep slaughter-house, in 2010. 23,000 lambs are processed annually [57].



Fig. 8. Fishing boat in "dry dock" at Narsarsuaq.

Modern sheep farming in South Greenland began with pastor Jens Chemnitz who started an operation in 1906 at Narsaq Kujalleq, a settlement 126 km south of Narsaq (Note that Greenlandic toponymy has a number of locations with duplicate or similar names). Another key figure in the development of the sheep undertaking was Lindemann Walsøe of the Danish Board of Greenland. Around 1912 Walsøe surveyed the region's soil and natural vegetation and concluded that several areas of hilly lush terrain along Tunulliarfik Fjord would be suitable for small-scale sheep farming [58]. In the decades that followed a number of sheep farms have been established in the Tunulliarfik Fjord region and 31 of the 53 registered sheep farms in Greenland are in the vicinity of Narsaq (fig. 9).



Fig. 9. Sheep farm located along the north shore of Tunulliarfik Fjord between Narsaq and Qassarsuk.

Largely because of sheep farming and partly because of tourism the area around Narsaq has a comparatively (for Greenland) extensive network of generally passable dirt and gravel roads, totalling over 120 kilometers (see fig. 10). The longest stretch of road traverses the northern end of Tunulliarfik Fjord and connects Sillisit, a tiny hamlet east of Narsaq with

Qassiarsuk. At times, with a capable vehicle it is possible to ford the meltwater stream and access the airport at Narsarsuaq from Qassiarsuk [Source: Correspondence with Ole Guldager].



Fig. 10. Roads connecting sheep operations near Qassiarsuk.

Qassiarsuk. In the early 20th Century Qassiarsuk had been a place where sheep farmers from Narsaq would come to gather grass and scrub vegetation for supplemental fodder [58]. There was no real settlement here except for a few people who were engaged in seasonal subsistence hunting and fishing. The modern era in Qassiarsuk begins in 1924 when Otto Frederiksen became a full-time sheep farmer on the same land where Erik the Red purportedly established his farm centuries before. In the warming climate the success of Frederiksen prompted others to enter the business and within several decades more than a dozen sheep farms had been established around the wide plains and undulating hillsides near Qassiarsuk. While most sheep farms are isolated places along the shore of Tunulliarfik Fjord, Qassiarsuk today is a place where sheep farmers live together in a village setting, most likely because of the expansiveness of arable land at this location.

In recent years agriculture around Qassiarsuk has seen incremental change as the climate warms further. The growing season lasts about three weeks longer than at the beginning of the 21st Century [59]. Along with the hayfields that will provide nourishment for the sheep during the long Greenlandic winter are fields of barley and small plots of potatoes and radishes. A few farmers are experimenting with broccoli and cauliflower.

Narsarsuaq. The “town” of Narsarsuaq is sited on a glacial outwash plain on the east side of Tunulliarfik Fjord. The snout of the Narsarsuaq Glacier (an outlet of the Inland Ice is about 8 kilometers away (fig. 11). The proximity to the ice and thin gravelly soils limited permanent settlement for hunters or farmers, although there is some evidence for what may have been a Norse farm nearby and a few Inuit tent rings

have been found. It would take an outside force to find full potential in the local geography.



Fig. 11. Narsarsuaq is situated on a glacial outwash plain.

During the Second World War when Denmark was occupied by Germany, responsibility for the security of Greenland was taken up by the United States which constructed several air bases on the island, one of which was Blue West One at Narsarsuaq. This location was selected by the American military in part because, despite cold temperatures, meteorological conditions were generally good for aviation year-around and air reconnaissance suggested the gravel surface here would facilitate and expedite construction of a runway. The aerial survey was only partly correct. While there was a gravel surface, a ground moraine, it was littered with innumerable large boulders that required arduous removal [60]. Construction began in July 1941 and the first aircraft landed in January 1942. Blue West One was used as a stopover point in ferrying aircraft to the European theater and as a base for search-and-rescue operations. Another purpose was potential defense of the cryolite mine located about 120 km from Narsarsuaq. At times during the war the base housed about 4,000 military personnel. After the war the base acted primarily as a refueling station for jet fighters crossing the North Atlantic. The gravel runway was repaved with concrete to accommodate these aircraft. The introduction of aerial refueling and the expansion of Thule Air Base further north made the base at Narsarsuaq unnecessary. The base was ceded to the Denmark in 1958 which redeveloped it into a civilian airport. Today regular flights to/from Reykavik, Iceland (on Air Iceland) and Copenhagen, Denmark (on Air Greenland) operate during the summer season, and there is year-around service to Nuuk, Kangerlussuaq, and other Greenland communities. In addition, commuter helicopter flights to Narsaq and other locations in South Greenland are based at Narsarsuaq.

The main function of Narsarsuaq is air transport and most economic activity in Narsarsuaq revolves around the airport, the Narsarsuaq Hotel, and tourist activities. About 18 per cent of all tourists to Greenland come to South Greenland [61]. Although the

region has experienced a decline in tourist revenue in recent years [62], the industry still supports a significant percentage of the laborforce with full-time, part-time, and casual employment. As Narsarsuaq is the gateway to the region and near a number of natural and historic attractions (e.g., Brattahlíð, Narsarsuaq Museum, Qooroq Icefjord, Narsarsuaq Glacier, and Gardar), many excursions start there. Two of the major providers are Blue Ice and Arctic Adventure.

In the vicinity of Narsarsuaq there is only a small amount of level land, mostly on the outwash plain and along the shore and agricultural land use is not as conspicuous as at Qassiarsuk. Only a few areas between the Flower Valley and the ridge before the glacial snout are in cultivation (fig. 12). Beekeeping is a recent activity tied to a warming climate found on the road from Narsarsuaq to the Flower Valley (fig. 13).



Fig. 12. Barley field located about 6 km northeast of Narsarsuaq.



Fig. 13. Research apiary at the Greenland Arboretum in Narsarsuaq.

The projects began a decade or so ago with limited success, but in recent years the activity is improving and today there are over one-half million bees in Narsarsuaq [63]. They are mainly a hardy variety of Nordic brown bees imported from northern Sweden. Some locales near Narsarsuaq are suitable for

beekeeping as northern willow, purple saxifrage, willow herb, and certain dandelions are good nectar producers. As there are no sheep-grazing areas in the immediate vicinity of Narsarsuaq, these flowering plants abound [64].

3.4. Potential future situation

Site and situation are dynamic. There are several recent developments that could impact nature, life, and economy along Tunulliarfik Fjord in the coming years.

Geologic forces have concentrated a large array of valuable minerals in the region's ancient igneous and metamorphic rocks. These deposits have never been seriously exploited except for the cryolite mine at Ivittutuut (120 km northwest of Narsaq) largely because of governmental policies and the technical and economic difficulties of extraction in a harsh remote environment [65]. This situation may be changing as Greenland's Home Rule government has recently relaxed mining regulations [66].

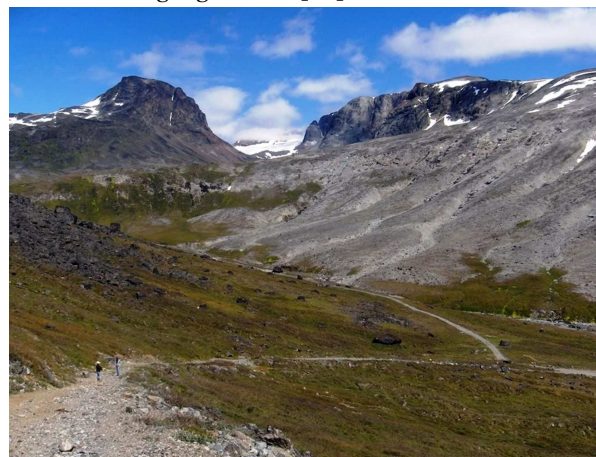


Fig. 14. The landscape around the Kvanefjeld mining site (Photograph courtesy of Poul Matthiasen).



Fig. 15. In the Greenland Arboretum.

A number of environmental and social impact assessments have already been conducted in the vicinity

of Tunulliarfik Fjord by Tanbreez Mining at a location across the fjord 12 km southwest of Narsaq. Their proposal is for an open pit mining operation to extract a number of resources including zirconia, rare earth elements, and niobium [67], [68]. There is also a great deal of speculation (seen in newspapers and heard in social gatherings) regarding the commercial mining of rare earths and uranium at Kvanefjeld (see fig. 14) which is located approximately 6 km north of Narsaq.

This may be one of the world's largest deposits of rare earths and may have, according to the chief geologist for Tanbreez Mining *"50% of the world's rare earth in it"* [69]. Exploratory mining had been conducted there in the past, but operations ceased in the 1980s. Feasibility studies and some environmental impact assessments have been performed. The primary company involved, Greenland Minerals and Energy Limited, hopes to initiate active open pit mining beginning in 2016 [70]. Such projects could be a mixed blessing for the region. Mining revenues could offset declines in the fisheries and alleviate some of the region's unemployment [67]. Narsaq's population has fallen by around 10% over the past five years and mining and construction jobs may entice some former residents to return. There are concerns that the operation will have detrimental environmental effects [71]. The open pit mine would be situated on top of a mountain and runoff downslope could endanger inhabited areas below. Radioactive dust fallout on Narsaq is another concern as is reclamation once the ore is exhausted. Residents of the region are divided on the issue, with some welcoming the economic boom that mining may bring and others expressing concern about the negative impacts on nature, traditional lifestyles, and tourism [source: *conversations with residents in June 2014*].

Beginning in the 1970s, a small number of experimental tree plantings were performed near Narsarsuaq and in time these formed the basis for the Greenland Arboretum (see fig. 15) that formally opened in August 2004. This preserve is located along and on Signal Hill. The purpose of this preserve was to establish a collection of trees and shrubs from the alpine and the arctic tree-line regions of the Northern Hemisphere. Aside from its recreational and tourist value, the preserve can serve as a climatic indicator.

With a warming climate there is increasing interest in developing forests in South Greenland. One study found that suitable climatic conditions exist in Greenland for the majority of the non-native boreal species studied [72]. The authors conclude that *"...expected near-future climatic changes will increase the climatic scope for the expansion of trees and shrub...and future warming is likely to allow growth of trees and shrubs across much of ice-free Greenland by year 2100..."* [72]. There is the possibility for enlargement of subarctic shrub ecosystems and boreal

forest ecosystems locally in South Greenland. In 1892 Scots pine and Norway spruce had been planted at Qanasiassat which is located along Tunulliarfik Fjord 10 km north of Narsarsuaq. These old trees have had over a century of intermittent slow growth and lethargy but recently they have become more energetic [59]. Over several decades this little plantation has been expanded. According to Kenneth Høegh, chief of the Agricultural Advisory Association, the establishment of the forest will provide future generations with information to evaluate the feasibility of establishing an actual forestry industry in South Greenland [73]. Fencing is being put in place and over 1200 trees, mainly Sitka spruce and Engelmann spruce, have been recently planted [74]. It will be at least a 100 hectare forest. The trees will not be harvested until they reach an age of 100–150 years.

The prospects of mineral exploitation, potential afforestation, and the specter of global warming have been at the forefront of discussions regarding South Greenland's site and situation for several decades. Now comes word of a more immediate conceivable change along Tunulliarfik Fjord. For several years the Home Rule government had been considering closing the airport at Narsarsuaq and constructing a new airport 40 km west at Qaqortoq on the Atlantic coast. It now appears that a decision may soon be rendered [75]. If the new airport is built, the airport at Narsarsuaq would either be shut down or relegated to limited small aircraft. Either option would essentially end most settlement at the site because most residents are employed by the airport (80 persons), the hotel, and tourism companies.

The impact on tourism could be devastating because currently Narsarsuaq is South Greenland's gateway. Essentially the town would die. This has happened in Greenland before when the government essentially forced residents and workers to relocate at Qullissat on Disko Island [76] and relocated entire Inuit villages to larger towns [77].

4. CONCLUSIONS

It has been demonstrated that site and situation are dynamic forces and their interplay through time influenced the cultural and economic history of the Tunulliarfik Fjord region of South Greenland. Climatic shift appears to have been the most influential factor in the rise of, adjustment of, and demise of settlement along the fjord. However, extrinsic factors and events have also played important roles, especially in the case of the Norse era and in the founding of Narsarsuaq.

With apparent global warming today, the face of South Greenland is once again changing and site characteristics may well undergo significant change and new situational advantages such as the exploitation of minerals could create new wealth for the population. But with these comes the possibility of domicide, the

erosion of traditional lifestyles, and the deterioration of pristine natural settings.

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