Sea Ice as Enemy and Friend: The Case of Iceland and Labrador/Nunatsiavut

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Introduction

Ertu kominn, landsins forni fjandi?
Fyrstur varstu enn ad sandi,
fyrr en sigling, sól og bjargarráð.
Silfurfloti, sendur oss að kvelja!
situr ei í stafni kerling Helja,
hungurdiskum hendandi yfir gráð

Have you come, our country's ancient enemy?
You arrived upon the sandy shore
Before sailing ship, sun and urgent help.
A fleet of silver, come to torment us!
Is that not the goddess Hell sitting in the bow?
Bringing us plates of hunger...

Hafisinn/The Sea Ice, Matthías Jochumsson
(Translated by Astrid Ogilvie and Níels Einarsson)

This paper draws upon a presentation given at the Sixth Open Assembly of the Northern Research Forum held in Hveragerði, Iceland in September 2011, and on a study *Syntheses of Sea-Ice, Climate and Human Systems in the Arctic and Subarctic* (*SYNICE*) involving a comparison of different sea-ice records, notably that of the Iceland and Labrador regions, funded by the National Science Foundation (USA). In addition to an analysis of sea-ice variations the project encompassed an evaluation of impacts of sea ice on the Icelandic population in historical times. The project also involved a pilot study on contemporary

impacts of sea-ice changes on communities in coastal Labrador. This latter aspect is currently being investigated further in another NSF-funded project *Understanding Climate-Driven Phenological Change: Observations, Adaptations and Cultural Implications in Northeastern Siberia and Labrador/Nunatsiavut* (*PHENARC*). The main focus of this paper is to show that, although recent variations in sea ice show similar patterns across the North Atlantic Arctic, including the records from Labrador and Iceland, the attitude towards sea ice in these two locations is very different. In Iceland, the ice has been regarded traditionally as an enemy, now seemingly being vanquished, while elsewhere, Arctic and Subarctic peoples, including those of Labrador, are mourning the loss of an old friend who is no longer faithful, but who has become fickle and unreliable. However, it should be noted that this paper lays no claims to being a detailed, in-depth analysis but seeks merely to highlight and to comment on this great difference between two North Atlantic cultures.

The focus here is thus on recent sea-ice variations, and also on the role of sea ice in the culture of these two Arctic/Subarctic populations, Iceland and coastal Labrador/Nunatsiavut, both geographically situated in the northern North Atlantic Ocean. The two locations make for an interesting comparison in that their respective relationships with ice could scarcely be more different. The Inuit and other aboriginal groups in Labrador have been honing their sea-ice skills for centuries while for Icelanders, sea ice was a deadly peril to be avoided at all costs. Nonetheless, there are excellent reasons for choosing these two locations for comparative study. Both have an economy that is based on fishing and other marine activities. In Labrador/Nunatsiavut there still exist both permanent communities and fishing stations - as was the case in Iceland in the past. Now the old fishing stations have either been abandoned or have become small towns. Both locations have a burgeoning tourist industry with both places seeking to attract tourists by advertising the quality and purity of their natural landscapes, and the excellent opportunities for whale watching. Both countries are developing hydro-electric power and are involved in the delicate balance between preserving unspoilt nature and in developing industries for much-needed revenue. Iceland and Labrador/Nunatsiavut have relatively low

population densities of approximately 319,600 (Statistics Iceland, 2012) and 27,000 (Statistics Canada, 2012) respectively. Apart from this, they have interesting historical connections in that Icelanders and Greenland Norse undoubtedly visited the coast of Labrador around the year 1000, and named the land they saw *Markland,* meaning "Forest-land" (Ogilvie *et al.* 2001). The name "Labrador" derives from the late-fifteenth century Portuguese explorer João Fernandes Lavrador. The Inuit self-governing region *Nunatsiavut*, meaning "our beautiful land" was created in 2005. Part of Labrador is also the ancestral homeland of the Innu peoples who call it *Nitassinan*. Labrador is highly culturally diverse (thus, for example, the community of Makkovik was settled in the 1890s by a Norwegian from Begnadalen in Oppland, Norway). However, the focus here is on the Inuit who call themselves the "sea-ice people" or *Sikumiut* in Inuktitut, the Inuit language (Borlase, 1993; Clarke, 1999). There were no native peoples on Iceland when it was settled in the late-ninth century onwards by colonisers who came primarily from Norway and the northern British Isles. As well as the similarities between Iceland and Labrador noted above, clearly great differences also exist, for example in terms of culture and language, and not least in their relationship with coastal sea ice. To Icelanders in the past, the ice that drifted to its coasts with the East Greenland Current brought with it famine and hardship. The recent trend towards a lack of ice is thus regarded as most fortunate in Iceland but, as elsewhere in the Arctic, it is causing numerous difficulties for the people of Labrador/Nunatsiavut.

Arctic Climate Change

Dramatic changes are currently occurring in the Arctic and Subarctic. These include: increasing temperatures, reductions in extent and thickness of sea ice, ice sheet and glacier mass; reduced snow extent and duration; thawing permafrost; and a general overall "greening" of the Arctic (see e.g. ACIA, 2005; www.arctic.noaa.gov/reportcard/). Of all these changes, sea-ice loss is perhaps the most evident (Stroeve *et al*., 2008; Serreze *et al*., 2009; SWIPA, 2011). Recent sea-ice losses are significant. Thus, for example, in the 2007 melt season, Arctic sea ice reached its lowest level since satellite measurements began in

1979. In 2008, it dropped to the second lowest level (Maslanik *et al*., 2007; Serreze *et al*., 2007; Stroeve *et al*., 2007; Stroeve *et al*., 2008; Stroeve *et al*., 2012). From 2008 through 2010 "… sea-ice extents remained substantially below the 1979-2000 average … In 2011, Artic sea ice nearly tied the 2007 record low" (http://nsidc.org/cryosphere/sotc/sea_ice.html). The Arctic sea ice September minimum extent also reached a new record low in 2012. "The last six years (2007-2012) have seen the six lowest minimum extents in the satellite record (since 1979). Over the last 11 years, a new record was set four times (2002, 2005, 2007, and 2012) and several other years saw near-record lows, particularly 2008 and 2011" (http://nsidc.org/arcticseaicenews/2011/09/).

Not only will the melting of sea ice lead to seasonal opening of potentially important marine transportation routes, but the reduced sea-ice extent and duration will cause significant changes in surface reflectivity, cloudiness, humidity, exchanges of heat and moisture, and ocean circulation. These, and other, changes will, in turn, affect global climate. Clearly, human and animal populations are also impacted, and the voices of indigenous and stakeholder populations all over the circumpolar arctic are to be heard expressing their concerns regarding the threat of diminishing sea ice to their traditional ways of life and what is occurring with *sila* – the Inuktitut word that means "climate and all things that surround human beings" (see, e.g., Huntington *et al*., 2001; Fox, 2003; AHDR, 2004; Krupnik *et al*., 2010). In this regard, coastal communities in Labrador/Nunatsiavut are no different.

Sea Ice and Locations of Iceland and Labrador

The island of Iceland is located in a climatologically sensitive area close to major and contrasting features of the Northern Hemisphere's atmospheric and oceanic circulations - at the intersection of cold Polar air and warmer Atlantic air, and the relatively warm Irminger current, and the colder East Iceland current. Because of this, Iceland is very

sensitive to minor fluctuations in the strength of these different air masses and ocean currents. This is one of the main causes of the variability of the climate of Iceland on all time scales, and Iceland's vulnerability to climate impacts in the past, and potentially in the future, is due, in large part, to this variability of the climate (Bergthórsson, 1969; Ogilvie, 1984a; 1991; 1992ab; 2001; 2005; 2010; Ogilvie and Jónsdóttir, 2000; Ogilvie and McGovern, 2000; Ogilvie and Jónsson, 2001). Iceland is also situated at the seasonal boundary of the Arctic sea ice, and this is another important feature of the climate (Ogilvie and Jónsson, 2001). The ice is carried southward by the East Greenland Current, and its extent varies considerably. It occurs most frequently off the coasts from late winter to early spring, but during severe seasons (currently rare) it can remain far into the summer and even the autumn. The months April and May were likely to have the greatest extent of ice, and September to December the least. The presence or absence of the ice has a considerable influence on the climate of Iceland, both directly because of its nature as a heat sink, and indirectly through the influence of sea ice on the atmospheric circulation over a much wider region. The proximity of the ice to Iceland's coasts is associated with a fall in both land and sea temperatures.

The coast of Labrador and the east coast of the island of Newfoundland are exposed to the cold Labrador Current resulting in a cold moist climate. The Labrador Current is the southerly component of the Labrador Sea gyre which mixes the West Greenland Current from the east side of the sea with the Polar Water of the Canadian Current flowing down from the Arctic channels to the north, and the fresher water flowing out from Hudson Bay through Hudson Strait at the northern tip of Labrador. It is this cold current that distributes sea ice and icebergs across the Grand Banks of Newfoundland and into the North Atlantic Ocean. Ice appears through local formation and drift from further north off the Labrador coast in late fall. In the past, drift ice could close off the harbour of St. John's in February, and in severe years, reach its greatest extent in late March or early April in a latitude of about 45°N. Ice in the Gulf of St. Lawrence forms *in situ* in fall and by January can start drifting out through the south side of Cabot Strait between Newfoundland and Cape

Breton. Its greatest extent is normally about mid-March, and in the most severe years can extend along the Scotian Shelf as far as Halifax, Nova Scotia, to the southwest, or about 43° north latitude to the south. In very severe years, the island of Newfoundland can be almost totally enclosed by sea ice, with ice from the gulf extending as far east as the French islands of St. Pierre and Miquelon, about mid-point along the south coast of Newfoundland, and by ice drifting with the Labrador Current and curling westward along the south coast to almost the same point. Ice is driven far on the Grand Banks by the cold winter northwesterly winds, and is associated with high NAO index values.

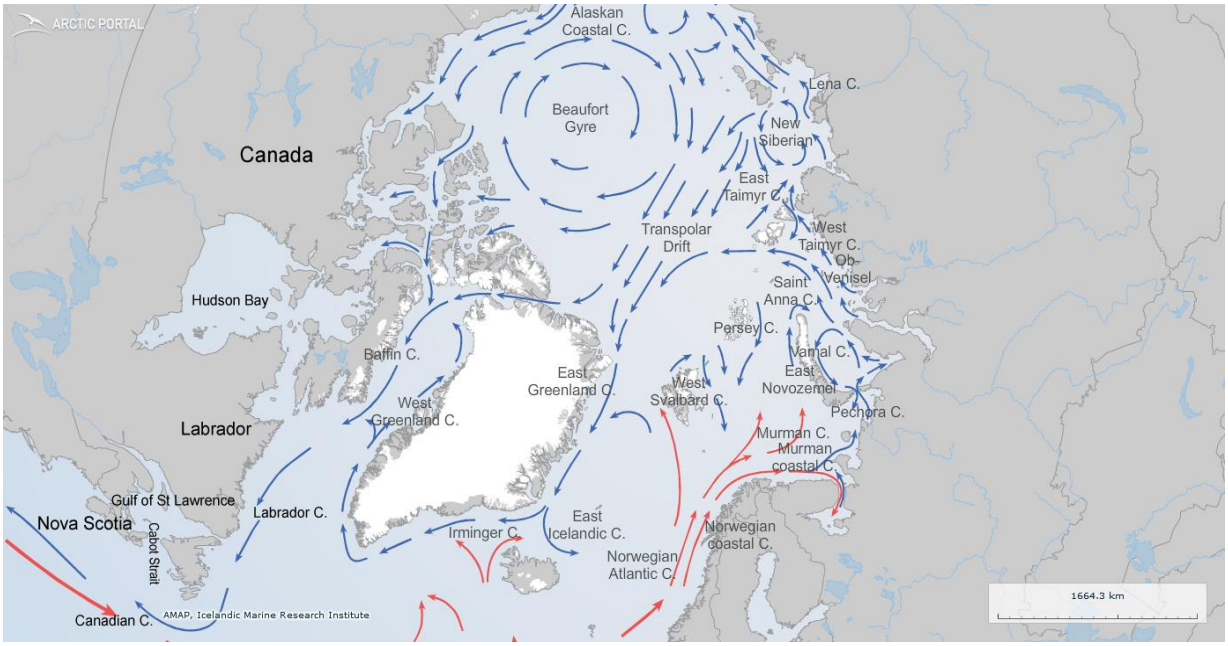

Figure 1. North Atlantic Ocean Currents. (Figure courtesy of Holmgímur Helgason and Arctic Portal http://arcticportal.org/).

Historical Sea-Ice Data for Iceland and Labrador

Prior to the era of systematic meteorological records and satellite data, information concerning sea-ice variations in North Atlantic/Arctic regions is available from documentary records and other climate proxy data. Three diverse but noteworthy sources of data that have been used in our reconstructions are described here. These are:

the records of the Moravian missionaries to Labrador; the Hydrographic Bulletins of the U.S. Hydrological Office; and official governmental reports from Iceland.

The Moravian missionaries established a number of settlements in Labrador. These included: Hopedale (1782); Zoar (1865); Nain (1771); Okak (1776); Hebron (1830) and Ramah (1871). Moravian culture and trade have significantly shaped northern Labrador and the lives of Inuit and settlers living there. The Moravian church is still a religious force in the region with approximately 2,500 members in four churches; (Nain, Hopedale, Makkovik, and Happy-Valley-Goose Bay (Rollmann, 2009). Information on climate, weather, and related matters were noted down in a variety of missionary documents. These records, to be found scattered throughout a number of European libraries and archives, have been the subject of tireless research by Gaston Demarée of the Royal Meteorological Office, Belgium, in collaboration with Astrid Ogilvie, and are proving to be a valuable source of climatic information. The journals were published as a way of keeping contact between the missionaries and their churches in Europe. Through the journals, funding was raised and gifts were collected for the missionaries far away. On his return, the missionary informed his church in Europe of the advances of his work. The interest of the homeland was frequently kept alive by giving secular information on the state of the country, the climatic conditions, the weather, etc. It is clear that information concerning the climate in northerly countries such as Labrador and Greenland was considered to be extremely interesting by contemporary readers. The journals travelled to Europe by means of the Moravian vessel that visited the Labrador stations in the summer of each year. For this reason, the information is organised in “ship-years”; this means roughly July of one year to August of the next. The exact day in which this period began or ended depended on many conditions, among them the pack ice and the meteorological conditions encountered crossing the Atlantic Ocean. The journals thus also provide detailed information on the presence or absence of sea ice during the journey, and near the Labrador coast. The missionaries also undertook instrumental meteorological observations (Demarée and Ogilvie, 2008; Demarée *et al*., 2010).

Another significant source of data for the Labrador/Newfoundland region is to be found in copies of *The Weekly Hydrographic Bulletin of the U.S. Hydrographic Office, 1889-1954*, located in the US National Archives in Washington, D.C. Information from these bulletins have been extracted by Brian Hill (together with Alan Ruffman). These bulletins had the object of placing "within reach of mariners, at no expense to them, such useful information as cannot be collected profitably by any private individual, but which the Government can readily gather, without any additional cost, through agencies already established." This information included mainly hazards to navigation such as the location of wrecks and derelicts, ice and icebergs, and during war and post-war years, the location of mines. Other meteorological and scientific observations also were often included (Hill, 1998; 2008; Hill *et al*., 2002; 2008).

Iceland is well-known for its rich literary tradition which includes a wealth of historical records containing accounts of climate and weather (Ogilvie, 2005; 2008; Ogilvie and Jónsson, 2001). The early part of the sea-ice record for Iceland used here is based on historical data, and particular use has been made of a valuable legacy from Danish rule (which lasted in effect from ca. 1536 to 1944) in the form of official reports describing conditions in Iceland and covering the period ca. 1700 to 1894. The reports were written one to three times a year by Icelandic officials known as *Sýslumenn* (Sheriffs) and *Amtmenn* (District Governors) and sent to the *Stiftamtmaður* or *Landshöfðingja* (Governors of Iceland). They are in manuscript form and are written in Danish, in Gothic handwriting. They were produced for all of the counties of Iceland (23) thus enabling comparison of conditions in different areas. The reports contain information on climate (especially temperature and precipitation) and sea-ice variations, as well as socio-economic information. They thus form a goldmine of climatic, environmental, and historical information. They are located in the National Archives in Iceland, and are currently being analysed by Astrid Ogilvie (Ogilvie, 2005, 2008). A translation of a letter for the sea-ice year of 1816, the so-called "Year Without A Summer" (see Ogilvie, 1992b) is given below.

Local-Knowledge Information

In recent times, emphasis has been placed on what is sometimes referred to as Traditional Ecological Knowledge (TEK). This refers to local and indigenous perceptions of environmental change, stability and variability. TEK may be constructed as data sets that can be analyzed quantitatively and linked with scientific records, data, and concepts for modeling. Incorporating TEK in scientific research is mutually beneficial and enriching. It can provide valuable information important to scientific research and enable researchers to communicate better and to share scientific findings. However, it may be noted that the gathering of TEK is no easy task. There is no single way to do it, and many perspectives are involved. In this regard it is very different from the traditional scientific method. See, e.g., (Huntington, 2005). TEK can generally be defined as a: " ... system of knowledge, practice and belief acquired through interaction with the environment and transmitted across generations" (Berkes, 2008). For the purpose of this paper no complex modelling or statistical analyses of TEK have been undertaken. However, the foundation for such analyses have been made during meetings with members of local communities in Labrador/Nunatsiavut) in the spring of 2007, and later in May and August 2011. These provide anecdotal local-knowledge evidence regarding recent changes in sea-ice conditions.

Impacts of Sea-Ice Variations in Iceland and Labrador

Broadly speaking, the impact of sea-ice variability on human life can be traced back to the role of the North Atlantic Oscilliation (NAO) seen as the Atlantic component of the Arctic Oscillation (AO) and potentially a forcing mechanism in the high Arctic climate system (Dickson *et al*. 2000). A positive NAO implies an anomalous low pressure over Iceland, leading to cold northwesterly winds over the Labrador Sea and warm easterly winds over the Greenland Sea. Under such circumstances the Labrador Sea will have more than average sea ice, its ports will be icebound and its climate will be colder than usual. The

warm easterly winds will push back the East Greenland ice westward, keeping the coasts of Iceland ice-free and the climate warmer than average. The Norwegian Atlantic Current will be stimulated, keeping the west side of Spitsbergen ice-free and warmer than usual. A negative NAO will have opposite effects.

A Perspective from the Past: Iceland

> *... the winter was among the best, but the spring was very cold, especially after the sea ice, which lay here for some time, had embraced the coasts. In the similarly cold summer, the grass growth was thus very poor. The hay harvest, which began in mid August, was hindered by frost, fog and cold chills as well as much snow on occasion, especially around 18 August and again on 19 to 26 September. It was also difficult to harvest the hay in the constant and severe rain in late September and early October...In the spring the inhabitants caught several sharks, and in the autumn a considerable number of cod and halibut…However, on 19 October the fishing stopped due to encroaching drift ice. The two whales washed up in the jurisdictional areas of Broddanes and Bær by the sea ice in June, helped much in preventing hunger deaths in the dearth at that time*. Extract from letter written by Sheriff Jón Jónsson, dated 3 January 1816, Bær, Hrútafirði, Strandasýsla (Translated by Astrid Ogilvie).

It is likely that Iceland owes its name to the presence of sea ice (Ogilvie, 2005) and this reflects the importance of sea ice for the country from earliest times. It is said that the first would-be settler, Flóki Vilgerðarson, gave it this name in a moment of pique and disappointment when he observed sea ice off the shores after a hard spring when his cattle died (Benediktsson, 1968). When settlers first went to Iceland in the late ninth century they brought with them an economy that was based on animal husbandry, primarily sheep and cattle, with supplementary fishing, and this remained the main economic pattern until fishing became a major industry in the late nineteenth century. For the most part, the

climate of Iceland has not been suitable for grain-growing and, until recent times, the main crop has been the grass upon which the livestock were dependent for winter fodder. The presence or absence of sea ice off the coasts traditionally had a major impact on grass-growth. This was because the proximity of sea ice had the effect of lowering temperatures on land. Colder temperatures would mean poor grass growth and hence a resulting lack of hay to feed livestock over the winter. If a shortage of fodder became acute, the animals would die of starvation over the winter. As they were dependent on milk and meat products for survival, this could result further in loss of human life (Friðriksson, 1969; Ogilvie, 1984b; 2001; Ogilvie and Jonsdottir, 2000). The presence of the ice off the coasts also led to other difficulties such as the prevention of fishing, and access by trading vessels. However, the proximity of sea ice could also have some positive effects. Useful products such as driftwood and marine mammals could accompany the ice. In stark prose, the report quoted at the start of this section describes several of these elements. A more literary description of sea ice may be found in the famous (in Iceland) poem entitled *Hafísinn* ("The Sea Ice") by the Icelandic poet Matthías Jochumsson (1835-1920). The first verse of this poem is given at the start of this paper. Here it is implied that the ice is deceptively beautiful, *a fleet of silver*, but this is come, not to delight, but to torment. And the fleet does not bring food,or useful goods, like normal trading vessels, but *plates of hunger*. The reference is to pancake ice, which also resembles empty plates, and is ironically suggesive of the fact that pancake ice brings, not sustenance, but starvation. Chief among all scourges, the ice is the worst – it is "the country's ancient enemy" – and, in referring to Hell, the goddess of the underworld, it evokes the one enemy that can never be defeated – death.

A Perspective from the Present: Labrador/Nunatsiavut

"*If the ice is treacherous, just walk lightly* .... " (Anonymous informant in Makkovik)

As is well documented, sea ice reaching the shores of Iceland is now rare, and the current climate is a backdrop to a life for modern Icelanders that is very different to the past. The lack of ice may be said to be a great blessing. However, in other Arctic and Subarctic regions the picture is very different. This has been documented extensively (Huntington *et al*., 2001, Gearheard *et al*., 2006; Krupnik *et al*., 2010). Discussions with local informants in Labrador/Nunatsiavut illustrate a similar story to those told in Greenland, Alaska and other parts of northern Canada. In this section, rather than give quotations from different informants there will be a general narrative that typifies the anecdotal evidence for drastic changes in sea-ice cover over the past 30 years or so. Invariably we were told that over the last 20-30 years "the winters have been different". In past times it would usually get cold at the end of October or beginning of November, and then there would be a steady increase in the cold. In the last 10 to 15 years "there has not even been proper freezing until January". There has been no long steady cold that makes the ice hard. One informant noted that if you get snow on top of the ice, it acts as insulation to keep it frozen hard. This happens less now. Another informant said: "The snow is no good now – no good for making snow houses – my children and grandchildren don't know how to do it." Thirty years ago people would go out to the *sina*, the ice edge, all the time. This has changed: "We are not seeing the heavy pack ice as before. This could stay to the first week in July. The ice used to extend for 80 to 90 miles, but not now. "We used to go out on the ice for days, looking for seals. Now we don't trust the ice anymore. People used to be able to look at the ice and see if it was safe to walk on. An elder is mentioned who said, if the ice was treacherous, "just walk lightly". Apparently people would even walk on loose ice, as long as the wind stayed on shore. In recent times many tragedies have occurred, with people falling through the ice. Perhaps the old friend is fast becoming an enemy, as the old ways are being lost "In the old days people had knowledge of the land but now they have GPS."

Overview of Recent Sea-Ice Variations

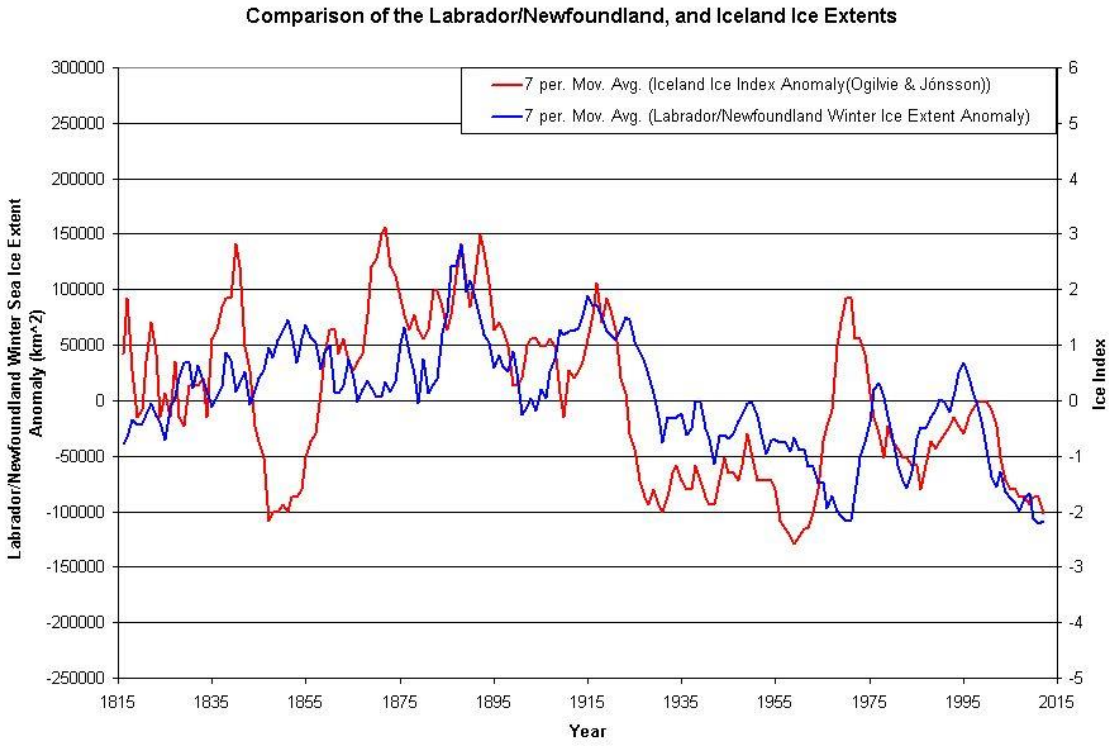

Figure 2. Comparison of Labrador/Newfoundland (blue) and Iceland (red) Ice Extents 1815-2012.

Perhaps the most striking aspect of the diagram is the great variability that can be seen over the period ca. 1815 to 2011 in both regions, but particularly for Iceland. For the most part, however, the diagram suggests relative agreement between the two locations. The early part of the period from around 1815 to shows heavy ice conditions for both Iceland and Labrador. From 1840 to 1854 there was little ice off the Icelandic coasts. However, in contrast, there continued to be relatively heavy ice concentrations in the Labrador/Newfoundland area. The latter part of the nineteenth century saw some very severe sea-ice years in Iceland, particularly in the 1860s and 1880s and the situation is similar for Labrador. From around 1903, sea ice falls off dramatically in Iceland and a corresponding pattern is seen in the Labrador/Newfoundland area. The twentieth-century decline in sea ice was interrupted in the Iceland area by the so-called “ice-years” of the

period 1965 to 1971. This period is also known as the “Great Salinity Anomaly” (Dickson, et al., 1988). A “lag” effect is seen in the Labrador region. After this time the two records seem to be agreement, doubtless to some extent due to the better data coverage available with the advent of satellite data. The decline in sea-ice extent of the early twenty-first century is also to be seen in both graphs.

Conclusions

As outlined above, for the most part, sea ice was considered a deadly enemy in Iceland and a “friend” in the Labrador/Nunatsiavut region. However, as with most human/environment relations, the situation is complex. When ice reached the coasts of Iceland in the past, it did sometimes bring positive benefits, and, for example, seal hunting on the ice was by no means unknown (Kristjánsson, Ogilvie *et al*., 2009). And now with diminishing sea ice in the Arctic it is becoming far less of a friendly entity for those who live there. The broader context here is that human settlements and natural ecosystems in Arctic/Subarctic regions are currently experiencing some of the earliest impacts of environmental change resulting from global warming. Syntheses of environmental and human systems research in these regions hold the potential to provide a rich theoretical and practical understanding of how people have developed adaptive systems in response to environmental change, stability, and variability in the past, and to develop tools for decision-making in the future. As the Arctic/Subarctic regions support a rich marine and terrestrial habitat surrounded by relatively densely populated nations, the rapid climate change and high interannual variability currently occurring in these areas (with greater changes predicted in the future; ACIA, 2005; Wigley, 2005; http://www.arctic.noaa.gov/reportcard/) means that it is a matter of urgency to assess the impacts of global change on humans and ecosystems in these areas. The documentary historical data highlighted here serve to provide a context for such changes.

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