The Domino Effect: Culture Change and Environmental Change in Newfoundland, 1500–1100 cal BP

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Abstract: This article examines the relationship between culture change and climate change in Newfoundland at 1500–1100 cal BP, a period during which two cultural groups lived there, Dorset Palaeoeskimos and Recent Indians. Dorset Palaeoeskimos were specialist seal hunters and Recent Indians practised a more generalized economy based on a mix of marine and terrestrial resources. We suggest that climate warming recorded in marine and lake proxy data from western Newfoundland, and dated at 1500–1100 cal BP, undermined the subsistence basis of a key Dorset site, Phillip's Garden, at Port au Choix. We speculate that warming sea surface temperatures might have occurred throughout coastal Newfoundland and if so might have undermined Dorset seal hunters in all regions. We also link Dorset population collapse to the abandonment of Phillip's Garden, which we hypothesize was a key site that facilitated social relations with Labrador. We argue that site abandonment disrupted important social networks, and as a result Dorset populations throughout Newfoundland became increasingly vulnerable in the face of increasing environmental stress on harp seal resources. At the same time, climate warming and the Dorset collapse positively impacted contemporaneous Recent Indian populations, enabling an increase in population and their expansion into areas vacated by Dorset.

Introduction

Our article examines the relationship between culture change and climate change in Newfoundland at 1500–1100 cal BP[1]. Our analysis is based on high-resolution palaeoenvironmental and archaeological data from Port au Choix in northwestern Newfoundland (fig. 1). From this basis we extrapolate to Newfoundland as a whole, for which no high resolution palaeoenvironmental data are currently available. While this article is similar to earlier approaches connecting culture change to climate change in the

Figure 1. Location map

North (McGhee 1972; Dekin 1972; Barry et al. 1977; Fitzhugh and Lamb 1985; Mudie et al. 2005), it differs in the resolution of our data and the integration of social factors into our explanations.

At 2000–1200 cal BP populations of both Dorset Palaeoeskimo and Recent Indian cultures occupied Newfoundland. These two cultures came from a different historical background and consequently each had a different world view and pattern of adaptation. Dorset Palaeoeskimos were specialist seal hunters and Recent Indians practised a more generalized economy based on a mix of marine and terrestrial resources. We suggest that climate warming dated at 1500–1100 cal BP on the northwestern coast of Newfoundland undermined the subsistence basis of a key Dorset site, Phillip's Garden at Port au Choix (fig. 1 inset). We speculate that this increased warming occurred throughout Newfoundland, where it negatively impacted the resource base of other Dorset populations. We suggest that for the Dorset throughout Newfoundland this impact was magnified through the collapse of Phillip's Garden, which we hypothesize was a key site that facilitated social relations with Labrador. We suggest that the synchronous collapse of Dorset across Newfoundland at around 1200 cal BP was a result of environmental change and the disruption of these social networks. At the same time, climate warming and the Dorset collapse positively impacted contemporaneous Recent Indian populations, enabling an increase in population and their expansion into areas vacated by Dorset.

Cultural Context: Dorset Palaeoeskimos and Recent Indians

Dorset Palaeoeskimos were an Arctic-adapted people who lived in Newfoundland 1990–1170 cal BP. Their origins lie in the eastern Arctic and it is presumed that they reached Newfoundland by way of Labrador. In contrast, Recent Indians were a boreal-adapted culture, and lived in Newfoundland from 2050 cal BP to the historic period. Their origins are unclear but are likely to lie in the Gulf of St. Lawrence and Atlantic Canada. The term Dorset Palaeoeskimo represents a single cultural category (Harp 1964; Linnamae 1975) within which there are some regional patterns (Robbins 1985; Leblanc 2000a; Erwin 2001). In contrast, the term Recent Indian encompasses greater cultural heterogeneity and subsumes three chronologically distinct yet overlapping cultural complexes (Penney 1985; Carignan 1977; Teal 2001; Hartery 2001; Hull 2002; Holly 2002; Erwin et al. 2005). The two younger of these Recent Indian complexes are the subject of this article: the Beaches complex (2050–950 cal BP) and the descendant Little Passage complex (1070–380 cal BP). Dorset and Beaches populations were contemporaneous in Newfoundland and Little Passage populations were subsequent to Dorset.

Dorset and Recent Indian site locations and the few preserved faunal assemblages indicate that different economic patterns characterized the two cultures. Dorset were specialist sea mammal hunters, relying in particular on harp seal herds. Faunal assemblages from Port au Choix consist mostly of seals (Murray 1992; Renouf 2002; Hodgetts 2005a, 2005b), although an assemblage from a Dorset site in nearby Bird Cove also includes caribou, beaver, and sea birds (Hodgetts et al. 2003). Most Dorset sites occur in coastal areas, in particular good seal hunting locations on exposed islands, headlands, and points of land (Pastore 1986; Schwarz 1994; Holly 1997, 2002; Rast 1999; Rast et al. 2004). In contrast, Recent Indian groups practised a more generalized economy, relying on a mix of marine and terrestrial resources. Faunal assemblages from Bonavista Bay and Notre Dame Bay indicate a wide range of exploited species, including small game, ducks and gull, caribou, black bear, freshwater and marine fish, and harbour and harp seals (Cumbaa 1984; Cridland 1998; Rowley-Conwy 1990). Recent Indian sites occur in both coastal and interior areas (Reader 1998; Schwarz 1994), in particular sheltered inner bays (Pastore 1986; Holly 1997, 2002; Rast 1999; Rast et al. 2004).

Based on site numbers and size, Dorset populations are larger than Recent Indian. There are 199 Dorset sites or site components identified in Newfoundland (fig. 2) according to the 2004 Provincial Archaeology Office site database, compared to only thirty-one Beaches Recent Indian sites or site components (fig. 3a) (Hull, pers comm 2004). Dorset sites are generally larger than Recent Indian sites. There are five Dorset sites larger than half a

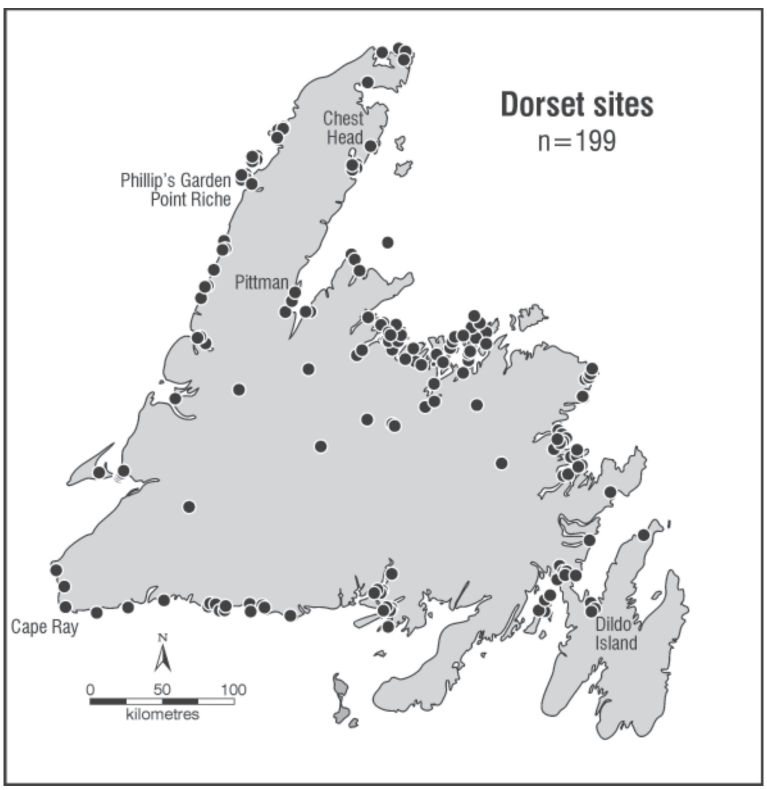

Figure 2. Dorset site distribution in Newfoundland. Large sites are named.

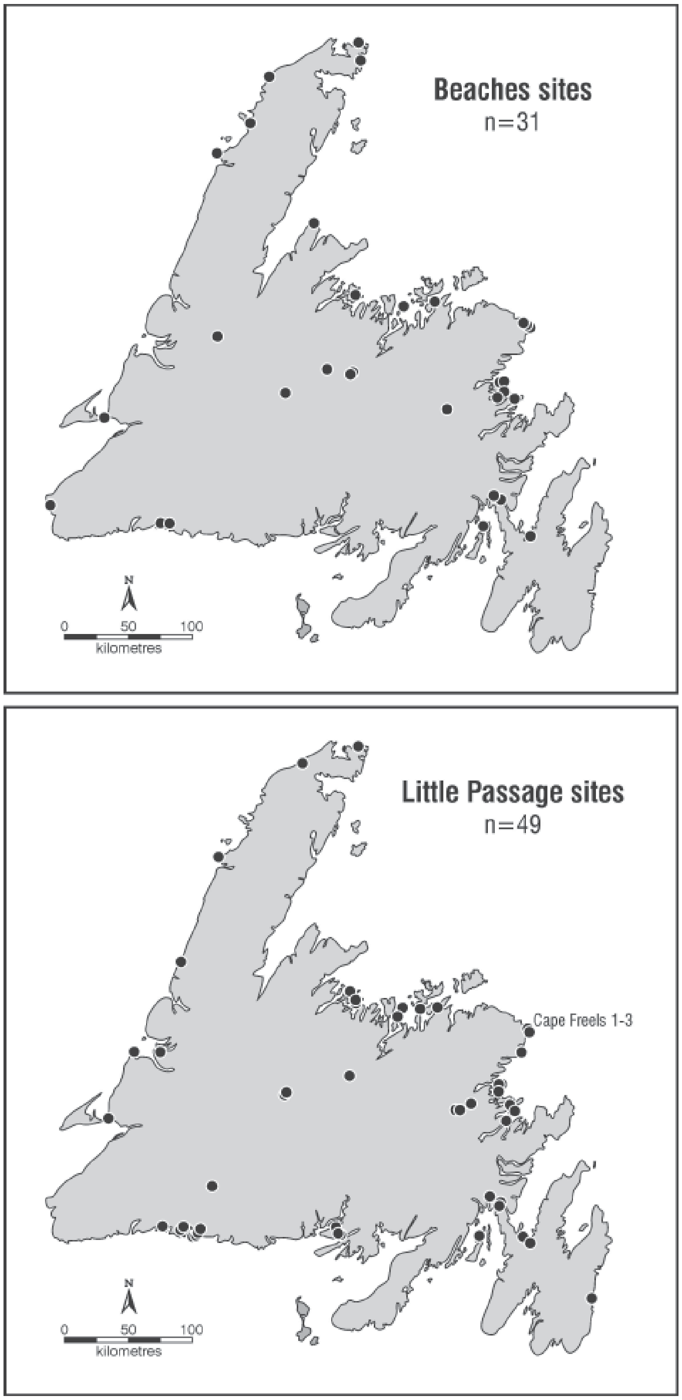

Figure 3. Distribution of a) Beaches complex and b) Little Passage complex sites in Newfoundland

hectare (fig. 2): Cape Ray on the southwest coast, the Pittman site in White Bay (Linnamae 1975; Fogt 1998), Point Riche and Phillip's Garden at Port au Choix (Harp 1976; Renouf 2002; Eastaugh 2002), Chest Head on the east coast of the Northern Peninsula (Renouf and Bell 2003; Penny and Renouf 2006), and the Dildo Island site in Trinity Bay (Leblanc 2003). There is only one Recent Indian site of comparable size, Cape Freels 1-3 in Bonavista Bay (fig. 3b) (Carignan 1977). Whereas the large Dorset sites have dwelling remains, middens, and rich artifact assemblages, Cape Freels 1-3 is more a palimpsest of hearths, each representing a short term encampment.

Populations of these two cultural groups lived side by side in Newfoundland. Their different economic patterns would have offset direct economic competition (Renouf 2003) and indeed their different areas of resource expertise might have been the basis for economic partnerships or exchange (Renouf et al. 2000). Acknowledgment of and accommodation to the presence of each other is reflected in the spatial separation of Dorset and Beaches sites within the same local areas or regions (Renouf 2003; Renouf and Bell in press; Rast et al. 2004).

The Local Scale

Of the known large Dorset sites in Newfoundland shown in figure 2, Phillip's Garden is by far the most intensively occupied (fig. 4) (Harp 1976; Renouf 2002) and is the subject of our high resolution archaeological and palaeoenvironmental data. This site is approximately two hectares and was occupied over 800 years, based on thirty-five charcoal-based radiocarbon dates ranging from 1990[2] to 1180 cal BP. Site occupation was not only lengthy but intensive. There are at least sixty-eight visible dwelling remains and a rich artifact inventory numbering over 30,000 specimens from twenty-four partially and fully excavated dwellings. There are also extensive deposits of well-preserved faunal material from several partially excavated middens, most of which are associated with dwellings. Site occupation is divided into three arbitrary phases based on the changing intensity of occupation derived from overlapping calibrated radiocarbon dates: early (1990–1550 cal BP), middle (1550–1350 cal BP), and late (1350–1180 cal BP) (fig. 5)[3]. Of the fifteen dated dwellings, one to three overlap during the early phase, four to seven from the middle phase, and two to three from the late phase. This suggests an initial low-to-medium population, increasing to a maximum, then returning to a medium level before abandonment (see also Harp 1976; Erwin 1995). Harp (1976) suggested that each dwelling housed one extended family or two related families. However, the large footprint of three recently re-excavated middle phase dwellings range from 88 to 103 m^2 (Cogswell

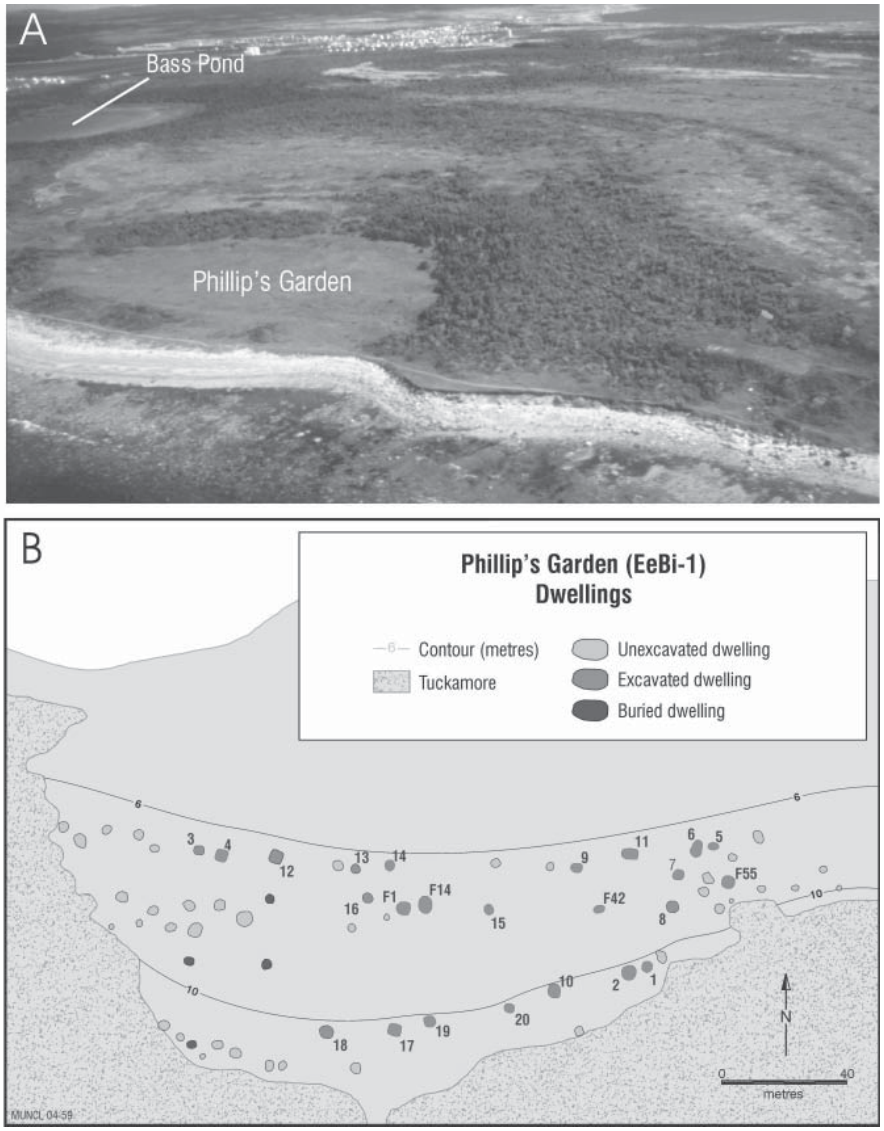

Figure 4. a) Oblique aerial photograph of Phillip's Garden site looking southeast across the Point Riche Peninsula with Port au Choix town in the background. Bass Pond, the focus of chironomid and other microfossil studies mentioned in the text, is located southeast of the site. b) Plan of Phillip's Garden site showing the remains of sixty-eight visible dwellings. Annotated ovals denote dwellings that have been excavated.

2006:49; Renouf 2006:125), suggesting that at least some of the dwellings housed several families and therefore that the population at the site, at least during the middle phase, was very large.

Faunal material from one dwelling (Murray 1992; Renouf and Murray 1999) and five sampled middens demonstrates that Phillip's Garden was a specialized seal hunting site. The faunal assemblages from the early, middle, and late phases are all dominated by seal (Murray 1992; Renouf 2002; Hodgetts et al. 2003). Of the Phocidae bones that could be identified to species, over 90 percent were harp seal and therefore it is likely that most of the bones that are identifiable only to Phocidae are harp as well. Today large harp seal herds migrate by Port au Choix twice yearly. In fall they swim from Greenland south to their breeding grounds in the Gulf of St. Lawrence, passing through the Strait of Belle Isle in December, in open water (Sergeant 1991). After they give birth to their young on the ice in April-May they begin their return journey, moving northward at the receding edge of the seasonal pack ice. A persistent ice lead occurs a few kilometres offshore from Phillip's Garden and harp seals congregate in this open water (Leblanc 1996, 2000b). According to local seal hunters, April-May is the best time for seal hunting

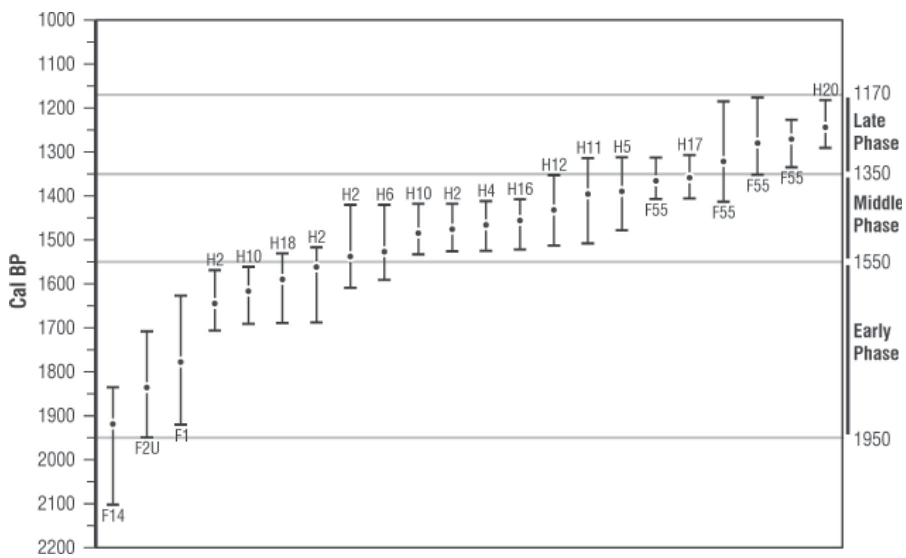

Figure 5. Dated dwellings at Phillip's Garden site. H# refers to a dwelling excavated by Elmer Harp (1976) and F# refers to a dwelling excavated by Renouf (2002). The vertical bar represents the one-sigma probability range for the calibrated radiocarbon date. The small circle within each bar represents the median probability calendar age.

because of this predictable offshore access (Leblanc 1996). By contrast, in December the seals may appear in any one of a number of areas: off the coast of Port au Choix, off the coast of the Quebec Lower North Shore, or in the middle of the Strait of Belle Isle. Although the archaeological bone assemblages indicate both a December (Hodgetts 2005a, 2005b) and an April-May seal hunt (Harp 1976; Murray 1992; Renouf 1993; Hodgetts et al. 2003), it is likely that the latter period was the more important focus of exploitation because of its predictability and the accessibility of the seals at the ice edge.

Not only were harp seals hunted from Phillip's Garden but their skins were processed for use in manufacturing clothing, boots, and other articles. This is demonstrated by specialized ground-slate skin processing tools that comprise 4.4 percent of the artifact collection (Renouf and Bell 2008). This is also demonstrated by disruptions across microfossil taxa from nearby Bass Pond that date to 2200–1400 cal BP, which we argue resulted from the practice of soaking sealskins to loosen the hair for depilation. Connected to this, we also argue that anomalous salinity values derived from chironomid taxa and dating to 2000–1400 cal BP are possibly the result of the subsequent step of sealskin tanning (Bell et al. 2005; Renouf and Bell in press).

The large scale of Phillip's Garden occupation suggests that this was a population aggregation site of the sort suggested by Mauss (1979) for the Inuit and characteristic of hunter-gatherer societies worldwide (Damas 1969a; Turnbull 1968; Lee 1972; Tonkinson 1978). While during most of the year hunter-gatherer populations are dispersed in small family groups, these family groups coalesce annually to engage in the social and ritual activities that reinforce and define their shared social identity. Population aggregation sites may occur where there are sufficient resources to support a large population (Tonkinson 1978) or where activities require coordinated group effort (Damas 1969b). Harp seal abundance and the labour-intensive tasks of meat butchering and skin processing would have provided both the means to support a large group and the necessity for coordinated effort. Binford's (2001:252) summary of the pattern of population dispersal and aggregation of Arctic societies shows that the size of periodic aggregations ranged from 64 to 350 persons with an average of 138 persons. It is likely that Phillip's Garden group size was at the larger end of that range.

The unique place of Phillip's Garden amongst Dorset sites in Newfoundland is undoubtedly connected to its rich resource base and its social function as a population aggregation site. However, it might also be connected to its proximity to Labrador, a short distance across the Strait of Belle Isle. Contact between Newfoundland and Labrador is apparent throughout all periods of Newfoundland and Labrador's prehistory, evidenced through stylistic similarities in tool types on both sides of the Strait of Belle Isle and through the presence of west coast Newfoundland cherts on Labrador sites and Ramah chert from northern Labrador on Newfoundland sites (Nagle 1986; Loring 2002). From 2000 to 1200 cal BP, the period when Dorset and Recent Indian populations both occupied Newfoundland, small amounts of west coast cherts are seen in Recent Indian sites on the Quebec Lower North Shore (Pintal 1998) and in Dorset sites in central and northern Labrador (Nagle 1986). At the same time period, Ramah chert is found in small amounts on virtually all Dorset sites in Newfoundland and also on most Beaches Recent Indian sites (Carignan 1975, 1977; Reader 1998; Hull 2002). Given that Ramah Bay was exclusively occupied by Dorset groups at the time suggests that the lines of communication across the Strait of Belle Isle were open not just between Dorset groups but between Dorset and Recent Indian populations.

This lithic exchange, while important in itself, is undoubtedly proxy for the less tangible network of social ties that connected populations in Newfoundland and Labrador. These ties would have been important for many reasons, not least of which was to ensure that there were near and distant bonds of mutual obligation that could be called upon in times of need (Speilmann 1986; Weissner 1982; Halstead and O'Shea 1989; Kelly 1995). In this way, where changes in temperature, wind, and ice could destabilize the availability of resources (Tuck and Pastore 1985), hunting and gathering populations of these northern areas were able to implement a social safety net (Renouf 1999). We speculate that not only is Phillip's Garden an important seal hunting and social aggregation site, but that it functioned as a gateway between Newfoundland and Labrador, facilitating regular contact across the Strait of Belle Isle.

Despite its obvious importance and prosperity, Phillip's Garden was abandoned by 1180 cal BP. The reasons for this are unclear; however, its abandonment coincides with a period of local environmental change, specifically a rise in air and sea surface temperatures and the near absence of sea ice.

Climate Change and Dorset Populations

The record of air temperature more than 1,000 years ago for Phillip's Garden is inferred from fossil insect evidence preserved in the sediment that slowly accumulated in nearby Bass Pond. Chironomids, or non-biting midges, are common aquatic insects. Because their life cycle is relatively short (a year or so) and there are many different midge species, each with distinct ecological requirements, their assemblages in lake sediments can be good indicators of present and past ecological conditions (Walker 2001). The adult midge deposit eggs in water which later hatch into larvae. As larvae they are one of the most abundant organisms living on the bottom of lakes and streams (Walker 1987). During various larval stages, a chitinous head capsule is shed. These head capsules are preserved in the accumulating lake sediment, producing the fossil record for palaeo-temperature reconstruction. On the basis of correlations between modern midge assemblages and various lake water conditions (e.g., temperature or chemistry), a statistical relationship can be established that allows past lake conditions to be quantitatively reconstructed on the basis of fossil midge assemblages (a transfer function; e.g., Walker et al. 1997).

Through application of their midge-temperature inference model for Bass Pond, Rosenberg et al. (2005) reconstructed a record of maximum summer surface water temperatures, which are typically four degrees Celsius higher than mean July air temperatures (Livingstone et al. 1999). Between 9000 and 5000 cal BP, inferred summer water temperatures were generally warm, varying between nineteen and twenty-three degrees Celsius. By 2200 cal BP, however, a slow cooling trend had resulted in minimum temperatures of sixteen degrees Celsius, or three to four degrees cooler than present (fig. 6a). A resurgence of temperate midge taxa heralded a relatively rapid warming

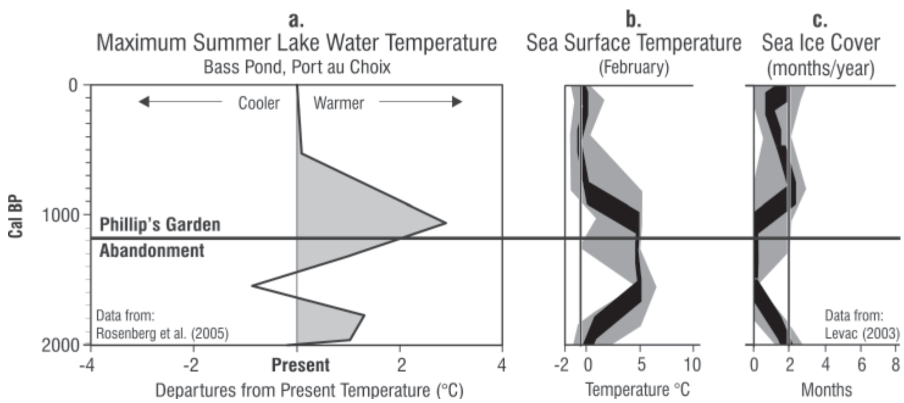

Figure 6. (a) Variations of summer lake water temperature from present for the last 2000 years based on chironomid remains in a sediment core from Bass Pond, Port au Choix. Chironomid data and temperature reconstructions are from Rosenberg (1998) and Rosenberg et al. (2005). (b)(c) Palaeo-sea surface conditions for Bay of Islands are derived by Levac (2003) from transfer functions using dinoflagellate cyst assemblages from a marine sediment core. The solid black line represents the best estimate, while the grey shaded area corresponds to the confidence interval. The vertical line through each curve indicates modern values. (c) The duration of sea-ice cover is the period of time for which at least 50 percent of the sea surface is covered by ice. Levac's (2003) radiocarbon chronology was calibrated to calendar years using Calib 4.4html (Stuiver and Reimer 1993).

trend, which, following a brief oscillation prior to 1500 cal BP, resulted in an increase of about four degrees Celsius in 400 years. The peak summer water temperature of twenty-two degrees Celsius was reached between 1100 and 1000 cal BP, after which there was steady decline to present temperature by 500 cal BP (Rosenberg et al. 2005).

Reconstructed marine climate conditions on the west coast of Newfoundland are inferred from century-scale, fossil dinoflagellate cyst assemblages preserved in Humber Arm, Bay of Islands, about two hundred kilometres south of Port au Choix (fig. 1). Dinoflagellates are single-celled organisms, many of which are photoautotrophs (i.e., primary producers employing photosynthesis) and are commonly referred to as phytoplankton (Dale and Dale 2002). They account for a substantial amount of the planktonic biomass, particularly in coastal and neritic (shelf) waters. Many dinoflagellate species produce a non-motile resting stage—a cyst—and it is the resistant walls of these cysts that accumulate in sediments, producing the fossil record.

The close statistical relationship between the distribution of dinoflagellate cysts and sea surface conditions in the North Atlantic (Rochon et al. 1999) provides the basis for the use of transfer functions for the reconstruction of century-scale changes in sea surface temperature and duration of sea ice cover in the Bay of Islands for the last 10,000 years (Levac 2003). Sea surface conditions were largely similar to those of the present day between 7000 and 5000 cal BP, but were periodically much higher than today's average between 5000 and 1000 cal BP. Winter (February) temperatures were up to five degrees Celsius higher, reaching a peak between 1500 and 1200 cal BP, while sea-ice cover was probably absent at 4200–3200 cal BP and 1500–1200 cal BP (fig. 6b-c).

In two faunal collections dating to 1420–1230 cal BP at Phillip's Garden, Hodgetts et al. (2003) show a shift away from the approximately 90–100 percent reliance on harp seal to a significant increase (approximately 20–30 percent) in the proportion of fish and birds, mirroring the decline in human population at around the same time. Palaeoclimatic data suggest that this same period was one of warmer seasonal temperatures and less severe sea ice conditions than present. How might these environmental changes have impacted Dorset Palaeoeskimo at Phillip's Garden? The pack ice might have been much lighter and present for a shorter duration thereby reducing the period of harp seal availability; the timing and distribution of the pack ice and associated harp seal herds might have been less predictable thus undermining an important aspect of the hunt; or the ice lead offshore of Phillip's Garden might have been larger and therefore the ice edge less accessible with small craft technology. We can only speculate. However, summer lake surface and winter sea surface temperatures appear to peak around the time of site abandonment, suggesting that continuously rising temperatures might have undermined the conditions of site use to the point where its large population was no longer supportable.

The Regional Scale

Table 1 shows the Dorset entry into and abandonment of Newfoundland across five regions: the Northern Peninsula, the north coast (Notre Dame Bay and White Bay), the northeast coast (Bonavista Bay and Trinity Bay), the south coast (Placentia Bay to Cape Ray), and the southwest coast (Cape Ray to Bay of Islands). While the dates of entry are not the same, with the earliest dates coming from the Northern Peninsula as would be expected of an Arctic population arriving via Labrador, the dates of abandonment are synchronous across four of the five regions, occurring at 1170 cal BP, using the younger limit of the one-sigma probability age ranges for calibrated dates. We do not know if Dorset groups moved out of Newfoundland (Renouf 1999) or became extinct (Tuck and Pastore 1985) but this simultaneous disappearance of a series of local populations across a widespread area can be characterized as a population collapse. We suggest that this is related to two factors: a speculated Island-wide warming trend at 1500–1100 cal BP similar to that seen at Phillip's Garden and Bay of Islands, and the abandonment of Phillip's Garden.

Table 1. Oldest and youngest ages (cal BP) for Dorset by region of Newfoundland

Region	n	Oldest date		Youngest date	
		median probability	1-sigma probability	median probability	1-sigma probability
Northern Peninsula	52*	1920	1950–1870	1180	1260–1170
North coast	9	1700	1820–1610	1130	1260–1060
Northeast coast	9	1820	1930–1710	1200	1290–1170
South coast	7	1760	1880–1690	1250	1350–1170
Southwest coast	1			1210	1300–1170

* Four radiocarbon dates from the Northern Peninsula are excluded. Three are excluded because they are anomalous: 2140 ± 100 (Beta-23976), 677 ± 45 (BGS-2321), 959 ± 45 (BGS-2254). One is excluded because of a large error range: 1030 ± 290 (TO-9555). These dates are expressed in radiocarbon years BP.

It is possible that the records of elevated lake and sea surface temperatures at 1500–1100 cal BP for the west coast of Newfoundland are local in nature. For instance, the chironomid assemblages in Bass Pond may be responding to shifts in lake chemistry that are unrelated to climate (cf. Bell et al. 2005). However, as Levac (2003) argued for the Bay of Islands record, the presence of warm-adapted dinoflagellate species that today are not found north of the Gulf of Maine and southwest Scotian Shelf lends support to the reconstruction of much warmer than present sea surface temperatures. Unfortunately, high resolution marine records to test this warming trend in other parts of coastal Newfoundland are largely absent or poorly constrained for this period (e.g., Dinn 2003). Meanwhile, the absence of a similar warm interval in marine records from elsewhere in Atlantic Canada may principally be due to the low resolution in the uppermost part of sediment cores (e.g., de Vernal et al. 1993) or their offshore location (e.g., Scott et al. 1989). Location may be a factor because the probable cause of the warming interval was increased winter solar energy (Levac 2003), which would have diminished effect in more open waters where changes in ocean current strength and position would be the dominant influence on such short time scales (Fillon 1976; Levac and de Vernal 1997). Finally, Mayewski et al. (2004) identified the period 1200–1000 cal BP as one of rapid climate change of worldwide significance, which may be attributable to increases in solar output and atmospheric carbon dioxide concentrations. They argue that climate since the end of the last glaciation has not been as stable as once generally thought, but rather it has been dynamic at scales significant to humans and ecosystems.

We therefore speculate that the warming conditions seen in the west coast records are a local example of a more general phenomenon that occurred throughout coastal Newfoundland. Such warming likely reduced sea ice cover extent and duration, thereby impacting the sea ice-dependent harp seal herds and, along with them, Dorset seal hunting populations. If these speculations are correct, Labrador social networks would have been crucial to the well-being of Dorset in Newfoundland. However, if these networks were disrupted by the abandonment of a key site at the gateway to Labrador as we suggest, then the entire Newfoundland-Labrador network of communications would be at risk. This would add to the stress of Newfoundland's already undermined Dorset populations and lead to their Island-wide collapse.

Climate Change and Recent Indian Populations

The same temperature changes that destabilized the Dorset settlement of Newfoundland would have affected the Recent Indian populations differently, based on their generalized economic pattern noted above. We speculate that higher winter sea surface temperatures would have resulted in less winter sea ice, earlier spring seasons, and increased productivity of inner coastal and interior resources such as sea birds, fish, small game, plant foods, and timber. In other words, the same marine climate conditions that would have undermined the specialized sea mammal Dorset adaptation would have favoured the more generalized, marine-terrestrial adapted Recent Indians.

This enabled the Recent Indian population in Newfoundland to expand, from thirty-one Beaches sites (contemporaneous with Dorset) to forty-nine Little Passage sites (subsequent to Dorset) (fig. 3a-b). Figures are based on the 2004 Provincial Archaeology Office site database.

The relationship between Dorset and Recent Indian populations before and after this temperature increase is complex (Holly 2005; Erwin et al. 2005) and can be addressed by looking at the pattern of site locations at the regional scale. We analyzed the spatial distribution of Recent Indian sites in Notre Dame Bay, Bonavista Bay, and Burgeo (Renouf and Bell in press). We concluded that Beaches populations were held in check by the more numerous and more settled Dorset, but with Dorset abandonment of the landscape about 1170 cal BP, Little Passage populations could expand into previously occupied areas, mostly in the inner coastal zone. Unfortunately, the timing of the Little Passage expansion is poorly known, except in the northeast where available radiocarbon dates show that the expansion occurred not long after Dorset abandonment at 1170 cal BP (tables 1 and 2) We suggest that two independent processes made the inner bay areas more attractive to Little Passage groups: the absence of Dorset groups and warmer sea surface conditions.

Table 2. Oldest ages (cal BP) for Little Passage Recent Indian sites by region of Newfoundland

Region	n*	Oldest date	
		median probability	1-sigma probability
Northern Peninsula	2	940	990–910
North coast	2	860	930–880
Northeast coast	16	1050	1090–960
South coast	1	550	560–510
Southwest coast	1	720	760–660

* One radiocarbon date from the interior is excluded: 335 ± 100 CP (I-6562)

Summary

This article addresses how increased temperatures at Port au Choix between 1500 and 1100 cal BP are contemporary with, and likely linked to, the abandonment of the Dorset site of Phillip's Garden. We speculate that this increase was a regional rather than local phenomenon, and therefore would have affected all Dorset populations in Newfoundland. We suggest that these groups would have been additionally stressed by the collapse of Phillip's Garden, which was a key site situated between Newfoundland and Labrador, and thus its collapse disrupted the social networks that had linked the two areas. Further, we argue that the increase in temperature that undermined the Dorset populations was beneficial for Recent Indian populations who had a different, more generalized economy less tied to ice conditions and situated more in inner bay areas. Not only did their resource base improve, but with the Dorset gone, areas of the landscape opened up. While aspects of our study are speculative, our approach illustrates the multi-faceted nature of human responses to physical and social environmental change. In particular we illustrate how change in the circumstances of one site can have a domino effect throughout a large region, how environmental change can affect different cultures differently, and how changes in one culture can indirectly impact another.

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Notes

1. cal BP = calibrated years before present. All dates reported in this article were calibrated using the Calib calibration computer program (Stuiver and Reimer 1993) and are represented by either their one-sigma probability range or their median probability age.
2. There is one older date of 2140 ± 100 radiocarbon years BP (Beta-23976), but since this date is anomalously old by 170 radiocarbon years in the context of ninety Dorset dates in Newfoundland, we exclude it from the definition of the chronological range of Phillip's Garden.
3. All radiocarbon dates from Dorset and Recent Indian sites in Newfoundland were calibrated in 2004 and tables 1 and 2 are based on the results. Radiocarbon dates from Phillip's Garden were recalibrated in 2005 and are in current use. Revisions to the calibration datasets used by Calib between 2004 and 2005 have resulted in slight differences in the one-sigma probability age range limits: for example, the upper limit of the oldest calibrated date changed from 1950 to 1990 cal BP, while the lower range limit for the youngest one changed from 1170 to 1180 cal BP.

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