

MARINE ARCHAEOLOGY OFFSHORE DIGBY NECK, BAY OF FUNDY

Prepared by

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TABLE OF CONTENTS

Summary	2
Introduction	2
Early Inhabitants and Artifacts	2
Early Migration Routes	3
Early Humans at Debert, Nova Scotia	3
Environment of Early Peoples	4
The Great Hiatus	4
Younger Dryas Cooling	5
Submerged Archaeological Sites	6
Digby Neck Ulu Discovery	6
Multibeam Bathymetric Survey	7
Multibeam Bathymetric Image	7
Multibeam Bathymetry Interpretation	8
Relationship of Seabed Ridge to Ulu	9
Implications for Marine Terminal Construction	9
Summary	10
References	12

Figure 1 13
Photograph of the ulu retrieved from the Bay of Fundy off Digby Neck by a scallop fisherman

Figure 2 14
Map of the Digby Neck and surrounding marine area of the Bay of Fundy showing the survey control for the multibeam bathymetric survey conducted from the CCGS Frederick G. Creed in 1999

Figure 3 15/16
Shaded and colour depth-coded multibeam bathymetric image of an area of the Bay of Fundy adjacent to Digby Neck centered off Sandy Cove. See Figure 2 for survey control. The survey was conducted in 1999 by the Geological Survey of Canada. 3B – colour depth bar for the multibeam bathymetric image

Figure 4 17
An interpretation of the multibeam bathymetry in Figure 3. A large ridge protrudes from the shoreline in a westerly direction. It is interpreted as an esker that would have been a beach protruding into the Bay of Fundy during lowered sea level stands.

Figure 5 18
Relative sea level curve for the coastal area of Maine, USA. It is based on carbon 14 dated shells and salt marsh peat, interpretation of former shorelines on seismic reflection data and paleodeltas. From Belknap et al., 1987.

SUMMARY

In my opinion, based on a marine geological, structural, sedimentological and bathymetric understanding of the Bay of Fundy, the location of the marine terminal offshore Digby Neck is the most optimum location for such a facility within the entire Bay of Fundy. It is located at the entrance to the Bay requiring no deep penetration of the Bay by shipping and has the closest deep water route to the adjacent Gulf of Maine from the Bay of Fundy. It occurs over a stable and hard bedrock seabed with no surficial sediments including sand and/or muddy sediments. It occurs along a typical Bay of Fundy coastal segment without anomalous bathymetric, bedrock, or sedimentological characteristics. The area has no active faults within the bedrock and is considered to have a low seismic risk.

Introduction

The maximum extent of glaciers during the last major glaciation, the Wisconsinan, was to cover all of Atlantic Canada and extend across the continental shelf and over the edge to water depths as deep as 800 m. The lands around the Bay of Fundy were first settled soon after the ice sheets retreated towards the northwest and after the Fundy embayment became ice free through calving of an ice stream and the generation of large icebergs about 13 000 - 14 000 years ago. Since then, the Bay and the surrounding area have greatly changed, largely as a result of fluctuations in climate and relative sea level. In early postglacial time sea level was much higher extending up to 45 m along the southwest coast of the Bay. Relative sea level quickly fell as a result of rapid crustal rebound in early postglacial time to a depth of approximately 60 m at 9 500 ybp. Sea level stood at this position for a short period of time and began to once again rise to the present shoreline over the past 9 500 years with the bulk of the rise occurring during the first 6 000 years. Human communities have adapted to the changing conditions in order to survive. The overall picture is still incomplete and there are some large gaps in the understanding. The following is a summary of the early history of inhabitants from Fundy Issues # 24, (Percy, 2003).

Early Inhabitants and Artifacts

Three different types of data and information provide the basis for an understanding of early human occupation. Artifacts are objects, such as stone arrowheads or scrapers that ancient hunters left behind. These artifacts offer insights into lifestyles and stages of cultural development. Secondly, oral traditions include the legends, stories, ceremonies and practices that are passed from generation to generation by the Native people of an area. These provide an understanding of earlier cultures and insights into ancient ways of integration with the natural world. Thirdly, written documents by the new settlers have been mainly produced during the past 400 years and provide an historical record.

One of the problems in using artefacts to interpret human history is that only the most durable objects have survived. The moist, acidic soils of the Maritimes rapidly decompose buried objects of wood, bone, bark, hide or natural fibres. All that usually remains of tools and weapons are the indestructible stone parts. Ancient cultures and ways of life can be reconstructed from these materials. Artefacts are usually more informative when found together at places of human settlement, rather than randomly scattered. However, the first Native people of Fundy are interpreted to have lived a mostly migratory existence, living for only short periods in seasonal encampments. The very few sites that have been found are scattered widely in space and time, making it difficult to develop a coherent understanding of human occupation of the area.

Early Migration Routes

Archaeological evidence suggests that humans arrived in North America from Asia. New evidence from the study of the offshore areas of British Columbia indicates that they most likely took a coastal route for migration along the west coast of Canada and not an interior route between glaciers approximately 21 000 years ago. At that time, the Fundy region, including eastern northern North America, lay beneath kilometre-thick ice sheets that extended across the present land areas and the continental shelf. No one could have lived in the region covered by glaciers at this time. The tribes that moved southward from Asia along the western Canadian coastal corridor where marine food was abundant, quickly spread south and east across the continent. One group followed the southern edge of the receding Laurentide Ice Sheet and at about 11 000 ybp moved into the region we now call the Maritimes and whose barren landscape would have just emerged from an ice cover.

Early Humans at Debert, Nova Scotia

The earliest evidence of people in the Maritimes was discovered beside the upper reaches of the Bay of Fundy. In 1948, blueberry pickers found a spear point and other stone artifacts at Debert near the north shore of Cobequid Bay. Over the next 15 years archaeologists studied these discoveries. In 1963-64, a team from the National Museum of Canada explored the area and their excavations revealed a number of sites of early human occupation scattered over a 9 hectare area. Stone hearths marked the location of ancient dwellings and provided charcoal fragments. Radio-carbon dating of these materials revealed that the site had been occupied about 10 600 years ago, a time period that corresponded to the Middle Stone Age in Europe. Approximately 4 500 stone artifacts of an early Palaeo-Indian culture were discovered at Debert. These included knives, spear-points, scrapers and awls made from chalcedony, a form of quartz. They had been shaped and sharpened by chipping flakes from the tools' edges. The spear points were an advanced design, with incised grooves on either side into which a bone or wooden shaft would have been fitted and tied with strips of sinew or hide. Larger tools

that were made from beach cobbles were probably used as heavy choppers or hammers. The large stone knives found may have been used for cutting up caribou and other game, while the different types of scrapers helped in the removal of fat from the hides. Some tools still had traces of organic material that was tentatively identified as caribou blood. Many of the stone tools were clearly designed for working with wood or bone, suggesting that other implements were made from such materials, although none have been found. In 1989, workers clearing tree stumps found two additional Palaeo-Indian sites nearby, named Belmont I and II, covering more than 20 hectares. The more than 700 artifacts found at these sites were almost identical to those at the Debert site. A 260 hectare area encompassing the three archaeological sites has since been designated a "special place" under the Nova Scotia Special Places Protection Act.

Environment of Early Peoples

The artifacts collected at Debert, along with other archaeological and geological information, have enabled scientists to interpret the environment of the Fundy region and its inhabitants of 10 000-11 000 years ago. At that time, only a few small glacial ice caps were thought to exist at higher elevations in central Nova Scotia, Cape Breton and the Gaspé Peninsula. The mean annual temperature was just below freezing and sea level was up to 60 metres lower than present in some areas and actually higher in others, making for a dramatically different geography and coast line. In the Gulf of Maine, Browns Bank and Georges Bank were large islands that effectively blocked the entrance to the Gulf of Maine - Bay of Fundy marine system. In the upper Bay, including Minas Basin and Cobequid Bay, a broad tundra plain underlain by permafrost existed. It was a barren landscape likely similar to much of Canada's Arctic today.

The finds at Debert unequivocally prove that people were present in Nova Scotia almost 11 000 years ago. However, our understanding of their lifestyle, social structure and use of natural resources is based mainly on circumstantial evidence and informed speculation. Nevertheless, we know more about these earliest people of the Fundy region than we do about those who followed them over the next 5 000 years.

The Great Hiatus

Almost nothing is known about the people who lived in the Maritimes from about 10 000 to 5 000 years ago. Archaeologists have labelled this blank stretch in our history "The Great Hiatus" (Tuck 1984) because of our inability to find remains of settlements or other artifacts from this period. Geological studies and other evidence reveal that at this time the climate, landscape and habitats were changing dramatically, and not for the better. A number of hypotheses have been put forward to explain the lack of evidence. One suggested that an unproductive (boreal) environment existed with a low carrying capacity for human population. This predicted that there would be few archaeological sites. More recent reviews of the palynological data have brought this theory into

question. Sanger (1975; 1979) and Tuck (1975) offered hypotheses related to sea level changes in the Gulf of Maine and coastlines of the Maritimes. Some scientists believe that variations in climate and sea level were large enough to make much of the region inhospitable to the herds of game and the hunters who depended upon them. The people may have migrated southward in search of a more plentiful and reliable food supply.

Younger Dryas Cooling

Recent research of the glacial history of Nova Scotia (Stea, et al., 1998) has provided a logical explanation and a new understanding for the lack of archaeological evidence during this period termed “the great hiatus”. Studies offshore on the adjacent continental shelf, in the nearshore and of the recent Nova Scotian gas pipeline trench that crosses the province, have provided substantial evidence that an event termed “Younger Dryas Cooling” dominated over a 400 year time span beginning at 10 600 ypb. This was a time of abrupt and pronounced climatic deterioration with local advancing glaciers and rapid cooling. A wide variety of glacial sediments were deposited over organic materials throughout the Maritime Provinces. Small land based glaciers were reactivated from pre-existing ice or reformed during this time. In the adjacent offshore there was an increase in storminess. Sea ice and icebergs were present and this environment produced a strong seismic marker (coarsening) in the sediments and iceberg furrows on the seabed. It is possible that this rapid cooling and glacial ice advance isolated the first group of early humans in Nova Scotia and either drove them out or resulted in their demise. The Younger Dryas has subsequently been found to be an event of global climate significance that represented a short period of climatic cooling during an otherwise post glacial warming trend.

It has been suggested that early humans may have altered their diet from a reliance on land based plants and animals to the abundant fish, shellfish and marine mammals present in the coastal waters. This would have placed the inhabitants on the ever changing coast. Evidence from other parts of eastern North America indicates that the people of this era had the tools and skills to hunt walrus, seals and small whales, as well as large fish. Marine mammals were plentiful in the region. These large marine species may have been hunted from seagoing dugout canoes. Evidence from the Magdalene Islands indicates that people in eastern Canada were constructing vessels suitable for use in the sea at least 9 000 years ago. In order to better exploit the abundant marine resources, people would have settled near the coast, particularly along protected estuaries. Today, the remains of any such coastal campsites lie offshore, submerged by the rise in sea level. A paleosealevel position at a present water depth of 60 m shows that the inner and northern area of the Bay of Fundy would have been substantially subaerially exposed. All early habitations of the time now lie submerged. This could account for the lack of information during the great hiatus. The inner Bay of Fundy is the seabed of the region that has been subjected to the most alteration since the glaciers receded. The presence of modern mobile sand in very large bedforms that could have covered artefacts also compounds the problem.

Submerged Archaeological Sites

Over the last 15 years evidence has been increasing for the presence of drowned coastal sites in the Gulf of Maine, Bay of Fundy, and off the coast of Prince Edward Island. Underwater archaeological research has been limited, but numerous artifacts have been recovered by scallop draggers. The size and shape of the mesh in the scallop bags means that only large artifacts will be recovered. A biface and plummet recovered by draggers off the shore of Eastern Blue Hill Bay, Maine, are believed to date to the Late Paleo-Indian and Early or Middle Archaic periods. A plummet is a stone artifact characteristic of the Archaic Period. It resembles a lopsided dumb-bell in shape with one bulbous end separated from the other by a narrower neck groove clearly designed for wrapping a cord around it. Plummets of different sizes have been found in the region, and there is much speculation about what they were used for. Smaller ones could have been decorative pendants worn around the neck. They might also have been used as weights for twirling and twisting together strands of bark or rush to produce twine for making mats, robes, nets or baskets

Fishing draggers have recovered artifacts off the shore of Mount Desert Island, Maine, including three large bifaces and three plummets. The Penobscot Bay site is located under about eight meters of water off the eastern end of Deer Island, Maine. Artifacts recovered by divers and fishing draggers at this site include an ulu, ground stone adzes and biface fragments, and these are believed to date to the Middle and early Late Archaic (Stright 1990). Two large ridged ulus have been recovered in Passamaquoddy Bay and one other from off the northeastern coast of Prince Edward Island (Keenlyside 1984). A full-channelled Archaic gouge was recently recovered off Indian Island, between Deer Island and Campobello Island, Passamaquoddy Bay, by marine biologists dragging for scallop samples (Black 1997). Virtually all of these materials are believed to pre-date the Late Archaic period on the Maritime Peninsula, and lend support to Tuck's hypothesis of continual coastal occupation.

Digby Neck Ulu Discovery

In 1997, a scallop fisherman, Clayton Oliver, retrieved an important archaeological artefact from the seabed of the Bay of Fundy near Sandy Cove during scallop dragging operations. Gravel is commonly brought to the surface with scallop rakes and nets. The object discovered was an ulu, which stands in Inuktituk for woman's knife. This stone implement is considered to be pre-contact (prehistoric) in age (David Keenlyside, personal communication, 1998). An ulu is a thin stone slate tool that probably functioned as a multi-purpose knife. In the Arctic context they were used until

historic times. Similar finds although considered rare, have been scalloped dragged from the seabed in New Brunswick and PEI as previously discussed. They generally date to between 6 500 years and 5 000 ybp.

The ulu in the Bay of Fundy was found off Sandy Cove and the fisherman provided coordinates for the location: 44 degrees, 33 minutes N and 66 degrees, 09 minutes W. The water depth was estimated at 50 fathoms, or 100 m. These numbers appear to have been rounded so the location is not likely precise. The ulu was passed to the Nova Scotia Museum and has been examined by David Christianson, Nova Scotia Museum, and David Keenlyside of the Canadian Museum of Civilization. This ulu has been identified as a ridge-backed type, in contrast to a plainer flat blade form which required a wood or bone grip for effective use (Figure 1). The ridge-backed form is considered the earlier. It is not known from where the ulu originated. An ulu is a very effective tool for butchering sea mammals and the preparation of their hides for boots and other clothing. Archaeological researchers met with the fisherman who discovered the ulu and he indicated that he had also recovered bone remains and possibly walrus tusks from the same seabed area.

Multibeam Bathymetric Survey

Following the discovery of the ulu, David Keenlyside contacted Gordon Fader of the Geological Survey of Canada in 1998 to discuss the nature of the seabed of the Bay of Fundy in the area of the ulu discovery. At the time the only existing published geological map was surficial sediment Map 4011G and accompanying report (Fader et al., 1977). Canadian Hydrographic Chart 4011 for the region shows only a circular bathymetric high with a depth of 18 fathoms adjacent to the Sandy Cove area off Digby Neck. The surficial mapping did not cover this nearshore area and the nearest mapped seabed further offshore showed it to consist of till deposited by glaciers and covered in gravel. However, a multibeam bathymetric survey was being planned for the Bay of Fundy for 1999 and it was decided that if time permitted, a small survey of the area off Sandy Cove, Digby Neck would be conducted to determine if there were any unique geological or other features on the seabed that could explain the ulu find. Indeed, a multibeam bathymetric survey was conducted in the Bay of Fundy from June 16 - 22, 1999, from the vessel *CCGS Frederick G. Creed* equipped with a Simrad EM 1000 multibeam bathymetric mapping system.

Multibeam Bathymetric Image

One of the five local areas surveyed in the Bay of Fundy during the study was centered offshore Sandy Cove, Digby Neck and the survey extended to the southwest to the area off Whites Point and to an area near Centreville in the northeast. The survey lines were run parallel to the coast (Figure 2). The multibeam bathymetric image (Figure 3) revealed several new features on the seabed that were previously unknown and one of

these features may provide an explanation for the location of the ulu. The most prominent feature of the area surveyed was a large tapering ridge projecting from the shoreline seaward for 3 nautical miles that terminated in over 100 m water depth. This ridge trends east-west and is much shallower than the surrounding seabed. Superimposed on the ridge are numerous straight and sinuous smaller ridges. To the north of the main ridge is a series of isolated linear mounds occurring in water depths of between 70 and 90 m. They appear aligned more or less east-west and southwest – northeast with a similar orientation to the large ridge. Additionally, on the image is a well-defined terrace at a water depth of approximately 50 m. The seabed plunges to a depth of 60 m to the west of the terrace and the seabed is steep but flat with smooth terrain at its base. A flattening of the seabed occurs at the base of the slope and the seabed is rough and hummocky in deeper water. South of the large ridge is a curvilinear ridge, in a horseshoe–shape, open to the northeast that likely represents a glacial ice stream-formed feature. On the terrace in the nearshore to depths of 40 m the seabed also consists of hummocky rough bottom. To the immediate north of the ridge is a cluster of three small linear ridges with fresh scoured moats surrounding them in 70 to 80 m water depth. The depressions are very similar morphologically to the moats that occur around large sandwaves in the inner Bay of Fundy in the Margaretsville dunefield. The scoured moats around the linear features attest to periodic modern strong currents. Although the multibeam bathymetry extends only to the northern area off Whites Point, the existing bathymetric chart 4011, shows no additional bathymetric anomalies further to the southwest, suggesting that the seabed has a similar character to that portrayed in the multibeam imagery.

Multibeam Bathymetry Interpretation

The interpretation of this multibeam bathymetry off Digby Neck is difficult as there are no sidescan sonar, seismic reflection profiles, samples and photographs from the seabed in this immediate area. However, an interpretation can be made based on the morphology of the features and comparison with similar features from elsewhere in the Bay of Fundy where such ground truth exists (Figure 4). The isolated elongated mounds north of the large ridge are interpreted as drumlins. Their orientation indicates that they were likely formed from ice centered over South Mountain to the northeast and not from ice to the north and west. They probably formed during the time of the Scotian Ice Divide when active ice was drawn down into the Bay of Fundy. The fact that the large ridge is sub parallel to the drumlins suggests that it also formed beneath a glacier and may represent an esker. Eskers are ridges of glacial material deposited in a sub ice linear cavity through the presence of moving water and sediment. Eskers are generally composed of well-sorted and clean sands and gravels. Similar ridges in the region with superimposed smaller bouldery linear ridges occur along the north flank of Browns Bank.

Relationship of Seabed Ridge to Ulu

The presence and morphology of the large ridge provides a possible explanation as to why the ulu may have been found near the ridge. Based on the sea level understanding of the Bay of Fundy, and in particular the area off Digby Neck, it is clear that at approximately 9 500 ybp relative sea level stood at a present depth of approximately - 60 m. This meant that the ridge protruded 1.8 km further offshore into the existing Bay of Fundy along an otherwise straight section of coast, much as it is today. The ridge persisted for several thousand years based on the sea level curves of submergence for this area of the Bay. Such a major morphological feature protruding from a straight coast would have provided an excellent haul-out location for early humans in the area. Additionally, the processing of mammal carcasses caught in the Bay would have been attempted at waterside, and this ridge composed of gravel and sand would have provided an ideal setting (beach) for such an activity. The additional discovery of walrus tusks and other bones by the scallop fisherman in the same area, also supports the idea that the ridge may have been a natural haul-out location for walrus and a prime hunting ground for early peoples.

Implications for Marine Terminal Construction

The discovery of a rare, important and very old artefact to the north of the proposed marine terminal suggests that other artefacts may also occur in the region. The discovery of the unusual seabed ridge to the north of the proposed marine terminal and an understanding of the sea level history provide a morphological and temporal framework for an understanding of the paleogeography of the region. In order to determine the potential for the future discovery of similar artefacts prior to marine terminal construction, a program of marine archaeology should be conducted at pile footprint seabed areas for the marine terminal. Application for archaeological work in Nova Scotia is the responsibility of the Nova Scotia Museum who administers the Provincial Special Places Protection Act and also the Treasure Trove Act which applies to marine heritage.

It is recommended that an application for an archaeological survey of the offshore area directly affected by the proposal be made to this agency and a systematic grid-based diver observation and photographic assessment be undertaken. Professional divers trained in archaeological techniques should conduct the surveys. In the event that artefacts are discovered, they should be photographed and assessed in their found location, documented and removed following Canadian Museum standards for preservation and transportation of marine artefacts. This includes placement in seawater storage containers and careful transportation to the Nova Scotia Museum for further study. A comprehensive report should also be completed on the diver observations and provided to the responsible agencies.

The large ridge (former beach) that occurs to the north of the proposed marine terminal offers the highest potential in the region for the discovery of marine artifacts. It is unlikely that artefacts will be discovered at the marine terminal location as the seabed is uniform and presents no unique morphological or sedimentological characteristics. In order to prevent any future damage or disturbance to the seabed of the large ridge trending east west to the north adjacent to Sandy Cove, shipping routes associated with the marine terminal should be positioned to avoid passage over the area to prevent unnecessary disturbance and reduce the possibility of anchoring.

Summary

The discovery of a rare artefact called an ulu and walrus tusks close to the proposed marine terminal suggests that other artefacts may also occur regionally. Ulu usually date from a period of time between 5 000 and 9 000 years ago and were used as multi purpose knives. Based on knowledge of the sea level history of the Bay of Fundy region, it is clear that early peoples would likely have focused their activities near the coastal zone which would have provided important sources of raw materials and food. Unfortunately, the old shorelines of that time period are now submerged below present sea level and may extend to depths as great as 60 m. It is however, possible to develop a morphological and temporal understanding of the paleogeography of the region.

A large ridge that protrudes 3 nautical km from the shoreline has been discovered at the seabed based on the collection and interpretation of multibeam bathymetry off Digby Neck. During the period of lowered sea levels, between 5 000 and 9 000 years ago, the ridge would have protruded into the Bay of Fundy as a significant and large beach and represented a likely haul-out location for early peoples. Other similar features do not appear along this coastal segment. The finding of the ulu close to the ridge also suggests that it may have been used as a location to process carcasses of large marine mammals. The fisherman who found the ulu also found walrus tusks and other bones lending support to such a use. The potential for the discovery of artefacts to the south of the ridge at the Whites Point marine terminal pile footprint location is considered to be low.

In order to determine if similar artefacts occur at the seabed, prior to marine terminal construction, a program of marine archaeology should be conducted across the pile footprint seabed areas for the marine terminal. Application for archaeological work should be made to the Nova Scotia museum who administers the Provincial Special Places Protection Act and also the Treasure Trove Act which applies to marine heritage. It is recommended that a systematic grid-based diver observation and photographic assessment be undertaken. Professional divers trained in archaeological techniques should conduct the surveys. In the event that artefacts are discovered, they should be photographed and assessed in their found location, documented and removed following Canadian Museum standards for preservation and transportation of marine artefacts,

placed in seawater storage and transported to the Nova Scotia Museum for further study. A comprehensive report should be completed on the diver observations.

To prevent potential future damage or disturbance to the seabed of the large ridge trending east west adjacent to Sandy Cove north of the proposed marine terminal construction site, shipping routes will be positioned to avoid passage over the area. This will reduce unnecessary disturbance of the area and reduce the possibility of contact with the seabed from anchoring.

Figure Captions

Figure 1. Photograph of the ulu retrieved from the Bay of Fundy off Digby Neck by a scallop fisherman.

Figure 2. Map of the Digby Neck and surrounding marine area of the Bay of Fundy showing the survey control for the multibeam bathymetric survey conducted from the CCGS Frederick G. Creed in 1999.

Figure 3. Shaded and colour depth-coded multibeam bathymetric image of an area of the Bay of Fundy adjacent to Digby Neck centered off Sandy Cove. See figure 2 for survey control. The survey was conducted in 1999 by the Geological Survey of Canada. 3B – colour depth bar for the multibeam bathymetric image.

Figure 4. An interpretation of the multibeam bathymetry in figure 3. A large ridge protrudes from the shoreline in a westerly direction. It is interpreted as an esker that would have been a beach protruding into the Bay of Fundy during lowered sea level stands.

Figure 5. Relative sea level curve for the coastal area of Maine, USA. It is based on carbon 14 dated shells and salt marsh peat, interpretation of former shorelines on seismic reflection data and paleodeltas. From Belknap et al., 1987.

References

- Belknap, D. F., Kelley, J. T. and Shipp, R. C., 1987. Quaternary stratigraphy of representative Maine estuaries. In: Fitzgerald, D. M. and Rosen, P. S. (eds.), *Glaciated Coasts*, Academic Press, San Diego, p. 177 -207.
- Black, D. W., 1997 A Native Artifact from the Ocean Floor near Indian Island. *Fieldnotes: The Newsletter of the New Brunswick Archaeological Society* 3(2):5-7.
- Fader, G. B. J., King, L. H. and MacLean, B., 1977 Surficial geology of the eastern Gulf of Maine and the Bay of Fundy. Geological Survey of Canada paper 76-17, 23 p.
- Keenlyside, D. L., 1984 "Ulus" and Spearpoints; Two New Archaeological Finds from Prince Edward Island. *The Island Magazine* (16):25-27.
- Percy, J. A., 2003. Living lightly on land and water, Fundy Issues #24, Bay of Fundy Ecosystem Partnership.
- Robinson, B., and J. B. Petersen, 1992 Early Holocene Occupation in the Central Gulf of Maine Region. In *Early Holocene occupation in Northern New England*, edited by B. Robinson, J. Petersen and A. Robinson, pp. 1-12. Occasional Papers in Maine Archaeology 9. Maine Historic Preservation Commission, Augusta.
- Sanger, D., 1975 Cultural Change as an Adaptive Process in the Maine-Maritimes Region. *Arctic Anthropology* 12(2):60-75.
- Sanger, D., 1979 Some Thoughts on the Scarcity of Archaeological Sites in Maine Between 10,000 and 5,000 years ago. In *Discovering Maine's Archaeological Heritage*, edited by D. Sanger, pp. 23-34. Maine Historic Preservation Commission, Augusta.
- Stea, R. R., Piper, D. J. W., Fader, G. B. J. and Boyd, R., 1998, Wisconsinan glacial and sea level history of Maritime Canada and the adjacent continental shelf: A correlation of land and sea events. *GSA Bulletin*, July 1998; v. 110, No 7, p. 821 – 845.
- Stright, M. J., 1990 Archaeological Sites on the North American Continental Shelf. *Geological Society of America, Centennial Special* 4:439-465.
- Tuck, J. A., 1975, The Northeastern Maritime Continuum: 8000 Years of Cultural Development in the Far Northeast. *Arctic Anthropology* 12(2):139-147.
- Tuck, J. A., 1984 *Maritime Provinces Prehistory*. National Museum of Man, Ottawa.

Figure 1



Figure 2

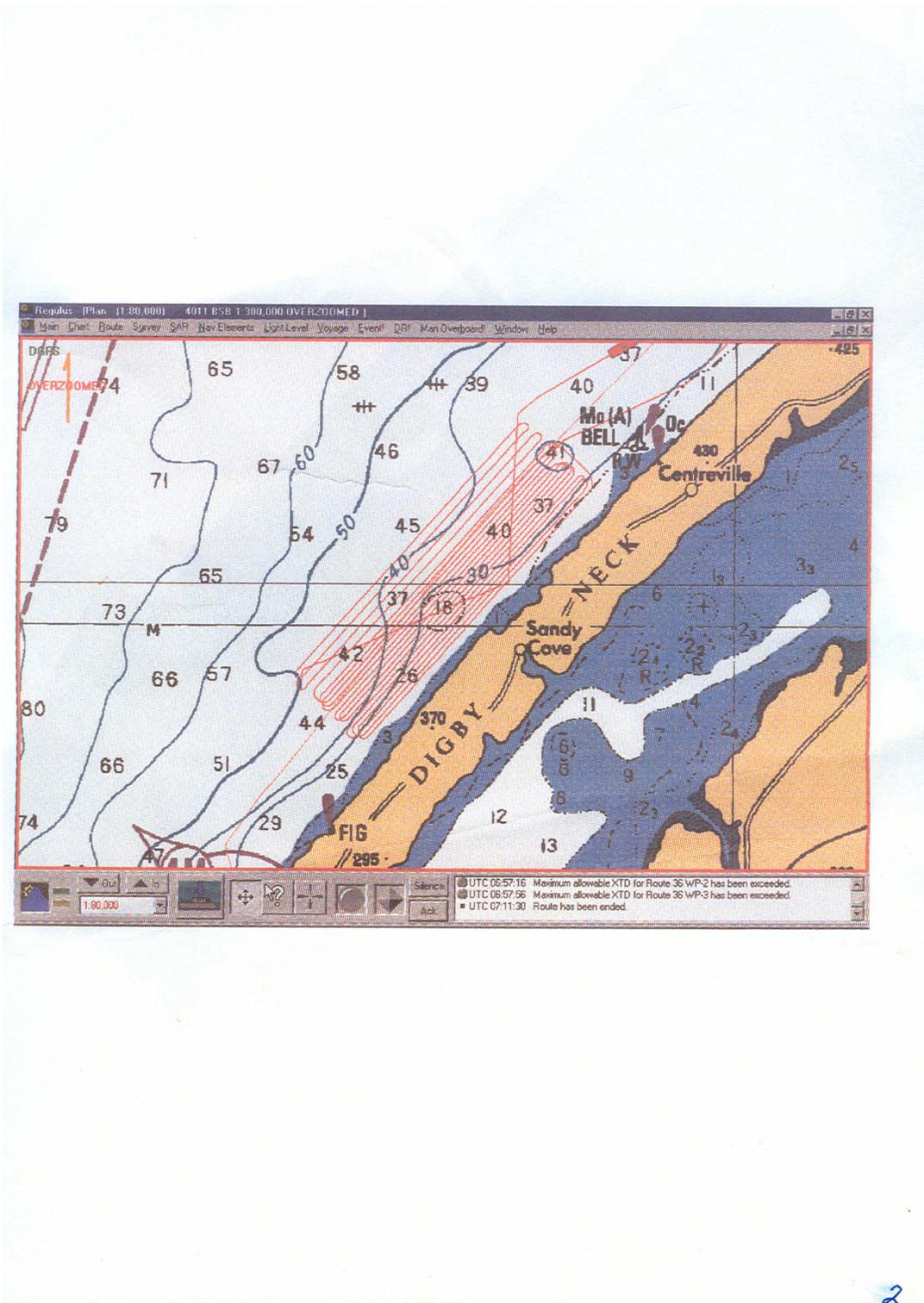
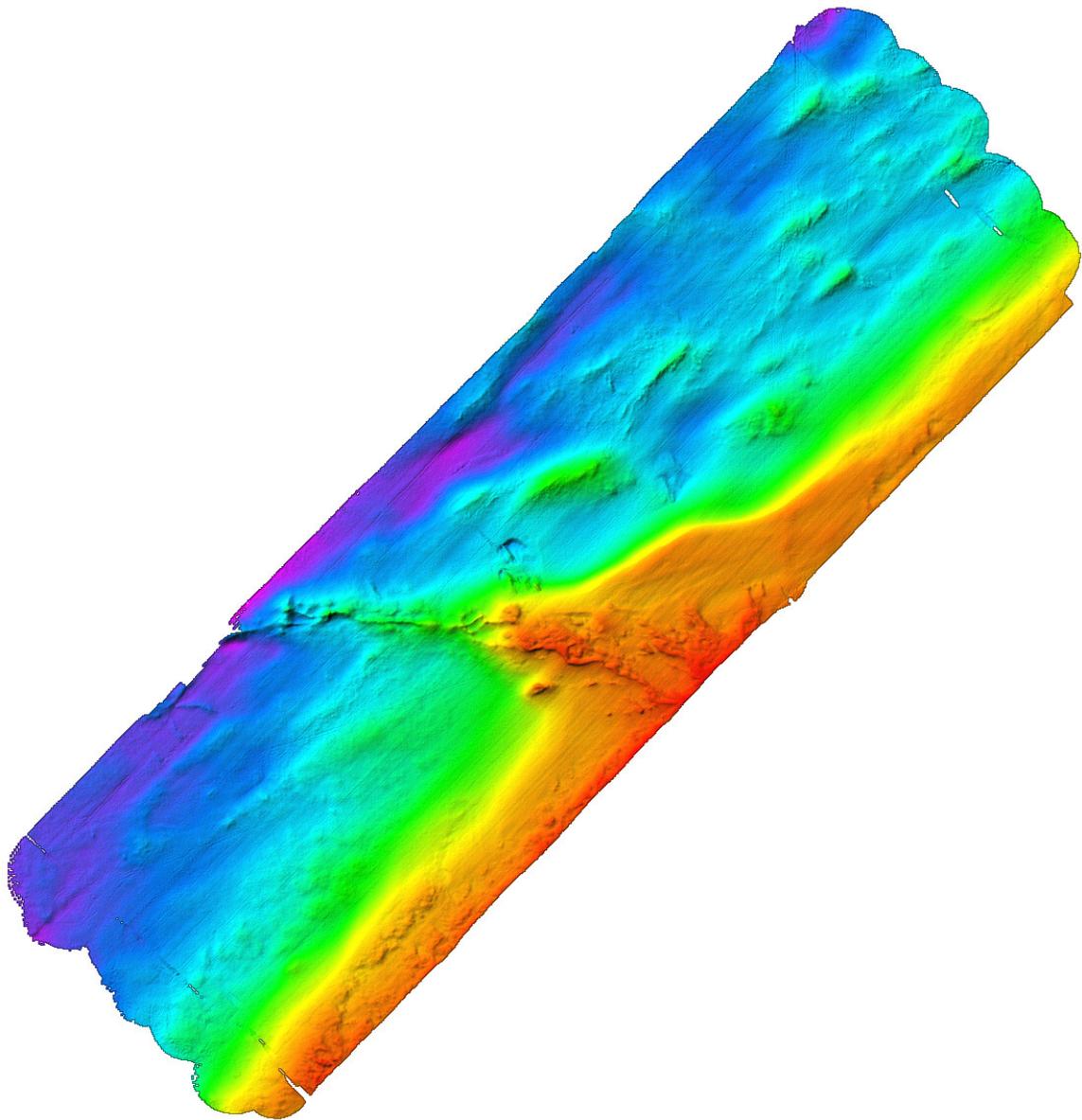


Figure 3



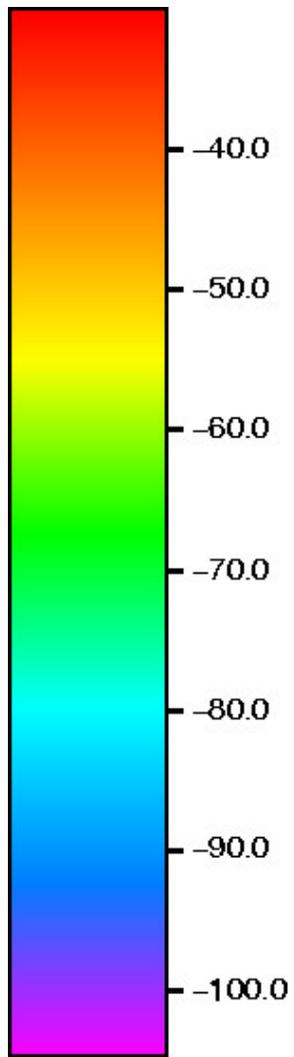
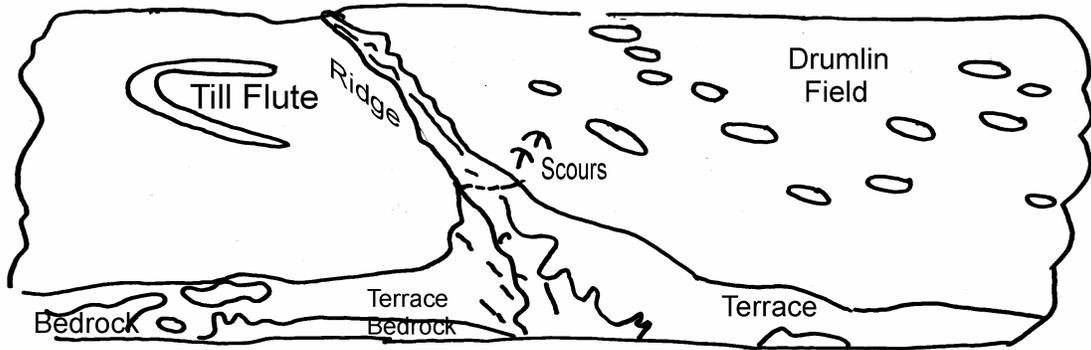


Figure 3A

Figure 4



4

Figure 5

