**Mapping with Indigenous Peoples in Canada.**

D. R. Fraser Taylor

**Abstract**

This chapter discusses the experience of the Geomatics and Cartographic Research Centre at Carleton University in Ottawa, which has been creating cybercartographic atlases with Indigenous communities in Canada for over fifteen years. The chapter describes some of the lessons learned in this ongoing process, including the important legal and ethical issues involved, as well as the development of the innovative Nunaliit data management framework used to create the atlases. A cybercartographic atlas is quite different from a conventional atlas, and is a metaphor for all kinds of qualitative and quantitative information linked by location. These are interactive, multimedia and multisensory on-line products. They are quite different from standard GIS products. The atlases are community controlled and community generated and telling stories from a community perspective is one of their central features. Both mapping and storytelling are basic human instincts. This chapter will describe some of the lessons emerging from this ongoing experience, one of which is the importance of the processes by which the atlases are produced which is equally, if not more important, than the products. Nunalliit means community in Inuktituk, and is the software framework used to produce the atlases. It has been designed so that communities can produce their own atlases rather than depend on external expertise. Community ownership and control is of great importance, and creating the atlases often requires a decentralised and distributed data management approach.

**1. Introduction**

The Geomatics and Cartographic Research Centre (GCRC) at Carleton University in Ottawa has been creating cybercartographic atlases with Indigenous communities in Canada for almost two decades. The initial approach, as outlined in *Cybercartography: Theory and Practice*, [[1]](#endnote-1)described the theory and practice of cybercartography and how the concept originated, but at that time there were few examples of Cybercartography being used in relationship to Indigenous mapping. Since that initial development phase, the GCRC has steadily increased the Indigenous mapping element of its work, and in 2014 published *Developments in the Theory and Practice of Cybercartography: Applications and Indigenous Mapping[[2]](#endnote-2)*. In that volume, detailed descriptions of a number of Indigenous atlases were given. In 2019, a study entitled *Further Developments in the Theory and Practice of Cybercartography: International Dimensions and Language Mapping* [[3]](#endnote-3)was released and again Indigenous mapping was a central element of the book. In addition to examples from Canada’s North, examples of Indigenous mapping in Mexico, Brazil and Kyrgyzstan were described. The year 2019 also saw the publication of a description of some of GCRC’s work on the topic of reconciliation with Indigenous Peoples – *Cybercartography in a Reconciliation Community: Engaging Intersecting Perspectives*[[4]](#endnote-4)*.*

This chapter will outline some of the lessons learned from this ongoing process as well as describe the development of the innovative mapping and data management framework, Nunaliit, used to create the cybercartographic atlases. A cybercartographic atlas is quite different from a conventional atlas and is a metaphor for all kinds of qualitative and quantitative information linked by location. These are interactive, multimedia and multisensory online products. Over the years, the atlases have become increasingly community controlled and community generated, and telling stories from a community perspective is one of the central features. Storytelling is a key aspect of all Indigenous societies, and Cybercartography’s ability to tell these stories using sound and videos is one of the reasons it is so useful in Indigenous mapping and why it has been so enthusiastically adopted by Indigenous Peoples. Nunaliit means community in Inuktitut, and has been designed so that communities can produce their own atlases. It is an open source framework freely available to all users and can be learned by individuals with limited computer expertise in a matter of hours. Community ownership and control is of great importance, and creating the atlases often requires a decentralized and distributed data management approach. The process by which atlases are produced by Indigenous communities is equally if not more important than the atlases themselves especially, in relation to inter-generational interactions created in the communities.

**2. Cybercartography and cybercartographic atlases**

Cybercartography was first introduced as a concept in 1997.[[5]](#endnote-5)Since that time both the theory and practice has evolved substantially, and much of this evolution has been the result of interactions with Indigenous communities.[[6]](#endnote-6)In 2019, Cybercartography was redefined as “… a complex, holistic, user centred process which applies location-based technologies to the analysis of all types of topics of interest to society and the presentation of the results in innovative ways through cybercartographic atlases. A cybercartographic atlas is a metaphor for all kinds of qualitative and quantitative information linked by location and displayed in innovative, interactive multimodal and multisensory formats”.[[7]](#endnote-7)These atlases empower Indigenous communities to tell their own stories. Both mapping and storytelling are basic human instincts and are a central part of the holistic nature of Cybercartography.

Although the formal definition of Cybercartography has changed, the six central ideas which underpin it are still relevant. These are:

* Individuals use all of their senses when observing what is around them. Cybercartography is exploring the use of all five senses and is now moving into affective issues to include emotion. In Indigenous mapping where storytelling is of central importance, sound, especially narration, is being widely used, as well as is music.
* Individuals have different learning preferences and prefer teaching and learning materials in different formats. Cybercartographic atlases provide the same information in multiple formats. For Indigenous mapping, narration has proven to be the format best suited to the informal learning process of transmission of information from the elders, which is of central importance. For formal education in a school setting, vision and text are more popular although selective use of narration is still important.
* Educational theory suggests that individuals learn best when they are actively rather than passively involved. Cybercartography engages and facilitates interaction. Cybercartographic atlases include a wide variety of representations of Indigenous community life, including art, music, place names, photographs, videos, ceremony, and socioeconomic and cultural activities, both past and present. Special attentions is given to the design of user interfaces to facilitate interaction.
* The social media revolution has given people the power to create their own maps and narratives. The Nunaliit cybercartographic atlas framework is a data management framework that allows Indigenous communities to enter the information they consider important from a community perspective, which is often quite different from that which outsiders would consider important. The framework is open source, provides a built-in meta data structure for the information and does not require special knowledge to enter the information. After a few hours training, community members can learn how to do this. Mastering Nunaliit is no more difficult than using the ubiquitous smart phones now common in Indigenous communities, especially with youth.
* Many topics of interest to society are complex, and the same set of “facts” on issues of interest to Indigenous communities such as environmental change and the health of species such as fish or caribou are open to a number of interpretations. Cybercartography allows the presentation of different ontologies and narratives on the same topics without privileging one over the other. Indigenous communities want their knowledge and experiences to be treated as equally important to that of western science, and Cybercartography allows this to happen. Traditionally, the map was an authoritative source of information, and what was mapped and how that was represented lay in the hands of those producing the maps who were almost without exception from outside the community.
* As the above comment suggests, traditional cartography was supply driven. National mapping agencies supplied definitive and authoritative maps which decision makers and others used. Technological change has more recently allowed a demand approach. Cybercartography takes this one step further and empowers individuals and communities to create their own maps, including the choice of what to map or not map. Cybercartography is democratizing mapping in new ways. Indigenous peoples, until recently, have often been largely “invisible” on maps or have been represented by others. Cybercartography gives voice to Indigenous peoples and other community groups both literally and metaphorically.

**3. The Nunaliit Cybercartographic Atlas Framework**

Nunaliit means community in Inuktitut, and the name of this open source framework reflects the underlying principles of Cybercartography as outlined in Section 2. The Nunaliit Cybercartographic Atlas Framework (https://nunaliit.org) is an open-source, web-based development framework [[8]](#endnote-8)and is the key software framework for the creation of cybercartographic atlases. The framework has been specifically designed to meet the needs of Indigenous communities although it does of course have many other applications.

**PLEASE INSERT FIGURE 1 here**

**Figure 1 Map of the Distributed Data Management Network for Local and Traditional Knowledge**

Nunaliit uses location, especially maps, as a unifying framework to link all kinds of qualitative and quantitative information. It is a means of telling stories in a compelling fashion, and it can provide interactions with information in multiple forms. A curated collection of information to tell a story on a single web page is called a module, and a linked collection of such modules is a cybercartographic atlas. Nunaliit development has been driven by the needs of its users in a collaborative and iterative process that combines the way the framework has been developed with capacity building for the user community. This process is particularly important for mapping with Indigenous communities. Existing tools and off the shelf software rarely adequately meet user needs, so our approach has been to develop a software framework collaboratively with Indigenous communities which is flexible, extremely easy to use, user controlled and inexpensive and which does not require programming skills to operate. Nunaliit has also been developed to have the interactive elements driven by data without the need to refactor these data elements for each different use. It uses open standards and is designed to work with data residing in different locations while facilitating new connections and the telling of new stories. Its development also reflects inter-project iterative development, [[9]](#endnote-9) where innovations in one atlas can lead to evolution in another. This, for example, is the case where the timeline development work on the Lake Huron Treaties Atlas[[10]](#endnote-10) contributed to the geonarrative timeline technological development of the Thule Atlas.[[11]](#endnote-11)

Nunaliit is fundamentally different from other interactive story driven systems now on the market. These systems, such as ESRI’s Story Map, have embedded data and structures in the application logic which require coding skills to update with new information. It is rare to find such skills within many Indigenous communities, so the use of such systems including Google Mash Ups often leads to a loss of control on the part of the Indigenous communities concerned, as well as to a loss of control over the data used to create the map. Data received by Nunaliit are stored in a platform neutral way, allowing users to employ other tools without having to go through Nunaliit or have any knowledge of Nunaliit data structures. This is a significant difference from other open source data management systems like Mediawiki and Drupal, which require the brokering of all requests for information through their own programming interfaces. Nunaliit has been designed to avoid dependence on rigid proprietary data structures and to encourage maximum interaction with other systems. Nunaliit is very flexible and components can operate independently and can easily be integrated into particular applications. It uses the new BSD open source licence and emphasises open standards for both data use and data sharing. Among its many attributes is its ability to ingest almost any kind of information. It can accommodate and use Indigenous languages, and this feature is of special value when mapping with Indigenous communities. Because it uses a flexible document-oriented data base, it has none of the rigidity of a system with a fixed schema approach. Often when mapping within an Indigenous community, the particular content requirements of that community emerge over time and often include data types which may not have been expected in advance. For example, the (now archived) Atlas of Arctic Bay includes a rap video by local youth entitled “Don’t call me Eskimo” whose lyrics are a compendium of the many issues facing young people in a small northern community. As Nunaliit continues to develop, new features are being added on a continuing basis. One of the more interesting recent developments has been the integration of the Garmin In Reach communication device with Nunaliit. [[12]](#endnote-12)

As part of a project with the community of Gjoa Haven, a team of academic researchers and an Inuit community organization were working on research on sustainable fisheries in the region. They were using Nunaliit to digitize, preserve and make available the mapped results of inventories on observed fish stock and related harvest information. As part of this research, a harvest study was carried out where hunters had Garmin In Reach GPS communication devices on their snow mobiles. In addition to locations, these devices have the ability to send positional information and messages via satellite to the vendors’ website where they could they would be extracted manually from the onscreen information. A new function in Nunaliit was created to allow information to be directly fed into the Atlas. In addition to the research values, the community could see where hunters were real time on the map and to respond to their messages by email.

Nunaliit continues to be built incrementally in cooperation with a number of Indigenous communities. Joint development of the software is accompanied by training and educational sessions. We have already had one session bringing twelve user communities and organizations together to learn from each other and to share experiences. Nunaliit documentation has been translated into Spanish and is in use by communities in Mexico [[13]](#endnote-13)and plans are underway for its use by Indigenous communities in Brazil. [[14]](#endnote-14)

Development of this innovative framework will continue in response to the needs of Indigenous communities and new ways will be found to tell their important stories. Unlike many information systems, Nunaliit uses a distributed data management system which allows communities to host and control their own information. It does not disappear into an anonymous cloud, controlled from outside. The centralized cloud-based systems are technologically very efficient, but a distributed data system is reflective of the strongly expressed desire by Indigenous communities to control their own information and to help avoid the misuse of that information which has unfortunately been so common in the past. The important ethical and legal issues involved will be discussed more fully later in this chapter.

**4. Mapping with Indigenous Peoples – Some Examples**

Over the last fifteen years, the Geomatics and Cartographic Research Centre (GCRC) has been involved in the production of cybercartographic atlases in cooperation and partnership with Indigenous communities and organizations. These can be viewed in the GCRC web site at <https://gcrc.carleton.ca/index.html>.

The communities and organizations involved include Arctic Bay, Sahtu, The Kitikmeot Heritage Society, Gwich'in, Gjoa Haven, Clyde River, Chesterfield inlet, Inuit Tapiriit Kanatami, the Nunavut Coastal Research Inventory of the Government of Nunavut, the National Centre for Truth and Reconciliation of Canada, Shingwauk Residential Schools Centre and the Children of Shingwauk Alumnus Association, amongst others. In many instances, the concept of the atlases has been generated within the communities themselves, who have approached GCRC for help in creating an atlas to respond to their own perceived needs. The community often provides the funds for atlas creation and in most cases the resulting atlas resides on a community-controlled server with a mirror site at GCRC. When the community uses its own resources, it is an indication that the atlas is being produced as a result of community needs, rather than at the initiative of outsiders. This “bottom up” approach is an important element in the theory and practice of Cybercartography as outlined in Section 3 and further elaborated in Taylor and Pyne [[15]](#endnote-15) and Taylor, Anonby and Murasugi [[16]](#endnote-16). In addition to the community and organization websites, and the GCRC website indicated above, descriptions of many of these atlases can be found in Taylor and Lauriault. [[17]](#endnote-17)

For the purposes of this chapter, a detailed description of the innovative approaches of the Kitikmeot Heritage Society (KHS) has been chosen, as it best illustrates how a community driven mapping process has developed over the last fifteen years. This summary is based on the chapters by Keith, Crockatt, and Hayes[[18]](#endnote-18).

KHS was incorporated in 1995 as a volunteer heritage organization with an elected Board of Directors primarily made up of elders from Cambridge Bay in Nunavut, Canada. Cambridge Bay is the centre of the Kitikmeot region with a mixed population, primarily Inuit beneficiaries of the Nunavut land claims agreement, which was the basis on which the Territory of Nunavut was created. Nunavut is one of three territories of the Canadian federation. Initially KHS served the community of Cambridge Bay, but over time has expanded to include the whole region. In 2001 KHS helped build a community library and cultural center which acts as the headquarters of the Society and houses museum quality cultural and archaeological exhibits. “The KHS preserves, protects and celebrates the history, culture, language and diversity of the people of the Kitikmeot region” [[19]](#endnote-19). The Society does this through a variety of means, including archiving the oral traditions and history of the elders and a variety of other activities.

An important element in these activities is mapping. In 2000, the Society began the systematic collection of Inuit place names and land use features of the Cambridge Bay region by consulting with elders and recording these on 1:250,000 topographic maps as well as video recording the stories related to each place. The KHS designed and printed its own 1:250,000 maps and distributed these to the various communities of the region. Keith, Crockatt, and Hayes comment, “While these maps were very popular and useful … they were not the right vehicle to ensure that all of the oral traditions collected during the project were made available to the public. Another form of cybercartographic product was needed to deliver on the KHS mandate to actively make available recorded oral traditions to promote their continued use by younger generations” [[20]](#endnote-20). In 2005, the KHS discovered Nunaliit and provided financial support to GCRC to build the Kitikmeot Place Names Atlas to respond to the goals and context set by KHS. All of the goals of the atlas were met and include: a continuous zoomable map; a talking map; a multimedia map; and a virtual visit. All of these functionalities were developed by GCRC in consultation with KHS. A Wiki map content was added to allow direct input from the community, and a dedicated atlas kiosk was established in the Community Centre to facilitate this. The atlas kiosk does not require knowledge of how to use a specific operating system or graphic user interface and is very easy to use. As a result of this function, the Kitikmeot Place Names Atlas is a “living atlas” which is constantly being updated by the community, who add new information and content. The decision on whether to finally incorporate the information provided is made by the KHS editorial board, which includes the elders of the communities involved.

The atlas resides on a server based in the cultural center and can be viewed at the KHS website <https://Kitikmeotheritage.ca>. There is a mirror site at Carleton University and the content of both sites is coordinated so updates take place at both sites in almost real time. It is important to KHS that the atlas resides in the community where it can be easily accessed. Band width and connectivity in the Canadian North, although improving, are still problematical, and it is important that the atlas be readily available to the Inuit communities it serves. A distributed data base approach is more effective in this respect than the technically more elegant cloud-based approach. Keith, Crockatt, and Hayes comment, “The Kitikmeot Place Names Atlas is an important example of how community-based heritage groups and academic institutions can collaborate to realize advancement in how technologies can be used by Inuit and First Nations to preserve and promote their language and culture. Through its collaboration with the GCRC the KHS has been able to accomplish one of its fundamental goals, which is to mobilize the products of cultural preservation projects so that they can contribute to the ongoing transmission of Inuit knowledge” [[21]](#endnote-21). KHS has been able to develop an interactive, multimedia cartographic product that allows for the transmission of Inuit traditional knowledge through the voices of Inuit knowledge holders themselves. In the Kitikmeot Place Names atlas, we see the beginnings of an Inuit adaptation of the technology of (cyber) cartography as an authentic vehicle for the transmission of place related traditional knowledge” [[22]](#endnote-22). Since 2014, the KHS has continued to add content to the Atlas, and has now expanded it and renamed the atlas as the Atlas of Inuit Place Names to reflect the fact that the atlas is being expanded to include place names from across the Arctic, not just the Kitikmeot region.

In 2014, KHS began a new and innovative mapping venture in cooperation with the GCRC and the National Museum of Denmark to produce the Thule Atlas [[23]](#endnote-23). Between 1921 and 1924 a Danish/Greenlandic expedition led by Knut Rasmussen completed the first comprehensive recording of Inuit societies in Canada. The expedition collected a vast amount of information in a variety of forms, and is a unique and comprehensive record of Inuit life at a time when Inuit were still living a pre-Christian world view and material lifestyle. The year 2021 will mark the 100th anniversary of Rasmussen’s Fifth Thule Expedition, and KHS was looking for a way to commemorate this event. They chose to develop an interactive multi-media atlas called the Thule Atlas to digitally return the wealth of cultural knowledge which resides predominantly in institutions in Denmark to contemporary Canadian Inuit. To do this KHS formed a partnership with the National Museum of Denmark and the GCRC. The National Museum of Denmark agreed to provided information from their large collection of documents and artifacts on the Fifth Thule Expedition, and discussions and interaction on the digital return issue continue. There have been two visits of KHS researchers to Denmark, one of which included Inuit elders. GCRC researchers have also visited Denmark to discuss technical transfer issues.

KHS outlined the four central requirements they needed to meet the project’s goals. These were:   
“ 1. Provide digital access to Inuit knowledge gathered on the expedition;

2. Provide opportunities for Inuit to verify and enhance knowledge collected by the expedition;

3. Link the results of contemporary research and Inuit experiences to expedition findings;

4. Create opportunities for Nunavummiut to interact with expedition objectives and environments in augmented reality environments.” [[24]](#endnote-24)

The Nunaliit Cybercartographic Atlas Framework described earlier in this chapter was the foundation of the approach developed to meet the four objectives. It tells stories and highlights relationships between multiple types of information and sources [[25]](#endnote-25) using location to connect and interact with information sources. The fact that Nunaliit does not have a fixed schema was particularly important to this project. This allows the flexible organization of data and results in a large non-linear web of knowledge which can be presented in many ways. “This unique design becomes particularly important in terms of a desire to create a database of Inuit knowledge that is actually amenable to Inuit structures for storing, teaching and using knowledge”[[26]](#endnote-26).

The interface design of the Atlas was created to meet the needs of different audiences including Inuit elders, community members and academic researchers. This resulted in three different but interconnected interface forms as shown in Figure 2.

**INSERT FIGURE 2**

**Figure 2. Select categories of knowledge tiles available to be explored by Atlas users.** [[27]](#endnote-27).

The first interface allows users to access all information cartographically; the second provides access to interactive PDF versions of all published Fifth Thule Expedition reports. A parallel version of these reports has been designed to allow community-based input whether this be a photograph, a book page or a transcribed song. This allows the amendment of the expedition information and placing it in a contemporary Inuit context by uploading videos, songs and other material. The third kind of interface allows users to access information by subject categories such as oral traditions, place names, photographs etc. This interface consists of a series of visual tools and is useful for research users and others interested in a specific topic. This interface exists as a series of visual ‘tiles,’ which can be navigated according to the user’s specific interests.

The Thule Atlas ([www.Thuleatlas.org](http://www.Thuleatlas.org)) is a work in progress. It is close to meeting one of its original goals of digitally returning the information on the Copper Inuit held in the collections of the National Museum of Denmark to the people of Nunavut. In this respect the partnership with the National Museum of Denmark is of great importance. The Museum, KHS and GCRC are breaking new ground with innovative new partnership approaches. In December 2017 a delegation from KHS including two elders visited the Museum to study the collections. The elders were able to provide information on many objects which they had seen used in their childhood by their parents and grandparents. The elders are “living archives,” and their involvement is of great value to the project. In June 2018 the GCRC hosted a joint workshop with KHS and the Museum during which a new ethnographic collections module was designed.

Digital return is becoming increasingly popular in the Museum sector, but the Fifth Thule Atlas is a unique example. The atlas is designed to guide Inuit with access to the knowledge collected in the expedition, but also goes well beyond this function by enabling Inuit to verify and enhance this knowledge through the contributions and comment functions in the atlas design. The atlas also enables Inuit to interact with the exhibition objects albeit in digital form and to reacquire skills lost as a result of the colonial experience the Inuit have faced since the Thule Expedition took place. Keith, Griebel, Gross and Jorgenson comment, “In the Fifth Thule Expedition Atlas, the KHS and its partners have developed an innovative test of digital return that both provides access to Inuit knowledge recorded among the Knowledge holders of the 1920s, and creates a space for commentary and discussion of contemporary Inuit concerning the correction or reinterpretation of expedition findings. If Inuit choose to adapt the online application as a primary resource, it holds potential to significantly expand the body of traditional knowledge available to contemporary Inuit to be selectively integrated into their emerging expressions of their language and culture” [[28]](#endnote-28).

**5. Legal and Ethical Issues of Mapping with Indigenous Peoples**

This is a topic of central importance to all kinds of relationships with Indigenous Peoples, which is now receiving increasing and much needed attention. In Canada these issues have been addressed by strict ethical guidelines created by academic research funding agencies and others, including several Indigenous organizations and Indigenous communities who have developed their own consent guidelines. As a result, the situation where traditional knowledge of Indigenous peoples was appropriated and often misused by outside researchers has improved. There are numerous examples of such unethical behaviour by researchers, and although this risk has been reduced by heightened awareness and tightened control and regulations in recent years, it has not been completely removed. One of the major problems is that traditional knowledge is rarely protected by national legal systems. Despite U.N. recognition current intellectual property, copyright and traditional law are totally incapable of protecting traditional knowledge. As Ogumanan [[29]](#endnote-29)has pointed out, these laws are based on western conceptions of what constitutes innovation and creativity, and are based on individual ownership. Given the legal gap in this respect, the solution must lie in “soft law” and ethical guidelines and permissions, and even here there are still many problems. Many of these guidelines and requirements were developed before the internet era, and issues such as informed consent and withdrawal of that consent are much more difficult and complex in the on-line mapping environment.

A comprehensive consideration of all of the issues involved is beyond the scope of this chapter, but they include consent, data storage, data access, data ownership and appropriate dissemination tools. GCRC has given all of the issues involved very careful consideration. Details of the issues and approaches used are given in Browne and Ljubicic [[30]](#endnote-30). A discussion of the approaches used by GCRC to address these challenges is given here.

Browne and Ljubicic point out that the root of the problem is a power imbalance between Indigenous peoples and the outside researchers involved in the mapping process. Building a working relationship of mutual trust with the Indigenous communities concerned is an important starting point, and to do this well takes time. It is a very important and integral part of the process by which GCRC atlases are created. Indigenous communities have too often been the objects of research, and GCRC is attempting to address this imbalance by finding ways to make them the subjects of such research endeavours. The most effective approach, as is illustrated by the description of our relationship with KHS given earlier, is to redress the power imbalance and to give the communities control of the mapping process. Capacity building required to achieve this is an integral part of the mapping process. GCRC has carried out several training workshops with KHS in both Cambridge Bay and Ottawa. The software and equipment required to both produce and display the map including a local server has been installed in the cultural center in Cambridge Bay. The training workshops also included another important aspect of the atlas creation process, which is the inter-generational transfer and sharing between the elders, who are the main knowledge holders, and youth of the community. The elders are rarely interested in using the computer to create maps, but they are eager to pass on their knowledge to the younger members of the community. The young people are much more interested in the technology, and as a result the mapping process is mutually rewarding.

Consent, data storage, data ownership and appropriate dissemination are all in the hands of KHS as is the choice of what to map. KHS has a clear idea of what it wants to achieve in the mapping process and it controls the agenda. GCRC’s role is to respond to this agenda and to make suggestions on how it can be achieved. Decision making in this respect is joint. KHS is also providing the funding to GCRC to carry out specific tasks, and this is a feature in almost all of the Indigenous ceremony atlases produced by GCRC. Scassa and Taylor observe that “These atlases in some instances are the first official recording of the aurally transmitted knowledge and elders and communities have authoritatively endorsed each record. The communities who have contributed to and authorized them regard the atlases as living archives”[[31]](#endnote-31). This is certainly the case with KHS which sees preservation of Inuit knowledge as a key aspect of its mandate.

In many ways having the atlases produced by a community organization like KHS has advantages over others produced by individual communities. The Heritage Society provides an institutional continuity which is important for the ongoing creation of the Atlases, and community processes which are used by KHS to create content can be continued over time helping resolve the issue of the need for consent by future contributors to the atlases.

Preservation and archiving of the interactive atlases over time remains a challenge. The GCRC approach to the challenge is outlined by Taylor and Lauriault [[32]](#endnote-32) where archiving is seen as an integral part of the life cycle of atlas creation. This proactive archiving approach holds great promise to ensure that the atlases will continue despite changes in technology which result in many websites becoming unusable over time. With effective archiving being considered as an integral part of the atlas creation and updating process, the likelihood of preservation is much improved, but still faces challenges.

Many Indigenous communities assume that they own the data included in the maps produced. This is rarely the case. A digital multimedia atlas is a “creation” and is automatically protected by copyright, so what is protected is the expression of that information, not the source. This distinction is not always full appreciated. If an outside organization produces a map or atlas, then the copyright is owned by that organization, and this can include the content. The community has de facto given up ownership of their own data. All GCRC atlases include a statement that the data in the atlases are owned by those contributing it. In the case of KHS, the copyright for the atlases lies with the society, and the atlases have their own URL on the KHS server. Mirror images are on the GCRC site, but the copyright and data ownership situations are clear.

Licensing is also a potential source of protection for Indigenous communities, and several communities and organization are defining their own licensing procedures. In Nunavut, for example, the Nunavut Research Institute is responsible for licencing all research projects. The GCRC has consulted widely with organizations and agencies responsible for the process, and has collaborated with the Canadian Internet and Public Policy Interest Clinic (CIPPC) in a report on licenses for local and Traditional Knowledge (LTK) in the context of digital cartography [[33]](#endnote-33). These important issues are now receiving international attention. In May 2019 the World Intellectual Property Organization (WIPO) met in Iqualit at a meeting organized by the federal government and Nunavut Tunngavik Inc. to identify and address gaps where the law inadequately deals with traditional knowledge. This builds on the substantial work on this topic in Australia by Mukurtu CMS (<http://Mukurtu.org>) and also includes consideration of an interactive on-line licensing system.

**6. Some Lessons Learned**

Mapping *with* Indigenous People is very different from mapping *for* Indigenous people. The KHS example given in the previous section illustrates the importance of the process by which the maps were created, and is a feature of almost all the atlases which GCRC has helped create over the years. This is much more than simply the use of technology to produce maps. Partnership and trust take time to develop, and to be successful, this time must be productively spent and requires a high degree of human interaction.

Mapping must respect and be driven by community needs. What is to be mapped and how it is to be mapped should be decided at the Indigenous community level. Often their desires can be a surprise to outsiders. One example of interest in this respect is the now archived cybercartographic Atlas of Arctic Bay. Here we learned that what was important to the community was quite different than what GCRC researchers expected: the small community of Arctic Bay decided that they wanted to include topics such as the important sled dog races in addition to the rap video. Three young children wanted to be sure that “Dead Dog Lake,” which was their fishing lake, was included in the Atlas. Frank Street was added as the first street name in Arctic Bay by a Frank who named the street on which he lived. Sometimes topics are controversial. Mapping systems must be flexible enough to ingest a variety of different forms of information and systems with fixed schema. Commercial mapping programs are rarely able to do this. The ability to listen is of great importance in community driven mapping, and GCRC is responsive to local needs. Note that many components of the Arctic Bay Atlas are now incorporated in a larger atlas, the Inuit Places atlas, that is bringing together the traditional place names of Inuit Peoples: <https://inuitplaces.org>.

The ideal situation is where the community can produce its own atlases. Nunaliit is designed to be used by individuals who have no special knowledge of geographic information processing systems or techniques. Although Nunaliit is very easy to use, capacity building is still required, and workshops to achieve this need to be included in the atlas creation process. Community dynamics are important. The main knowledge holders in many communities are the elders. Few elders are familiar with computer technology, but they are anxious to share their knowledge with younger generations. Young people are keen to learn from the wisdom of the elders and at the same time are comfortable with computer technologies. This has proven to be an ideal situation for the creation of atlases, as is illustrated by the examples given in this chapter. The ontologies of Indigenous peoples are quite different from those of Western science. These ontologies and the knowledge they contain and reflect are a parallel system of knowledge which must be accepted as such. It is not enough only to include traditional knowledge when it helps illustrate or expand on Western “scientific” research. In working with the Inuit, for example, it is critical to fully appreciate Qaujimajatuqangit, the term used to describe Inuit epistemology or the Indigenous knowledge of the Inuit. This requires an ability by Western researchers to listen, with some authorities emphasizing the need for “deep listening” in this respect. Semantics are challenging here as English translations of Indigenous concepts often do note capture the full meaning. Humans are only one actor in the complexity of Indigenous concepts of environment and not the center of that concept as they are in Western science.

Oral traditions and storytelling are both central to Indigenous societies. Mapping, which is only visual in nature, rarely captures this effectively. At a minimum, effective “mapping” must include an ability to capture and tell these stories. The multimedia and multisensory nature of cybercartography is valuable in this respect. The ethical and legal issues surrounding the mapping of traditional knowledge are implicit. As argued in this chapter, an effective response requires a change in the current unequal power relationships between Indigenous communities and Western mapping “experts”. At a minimum this requires the development of an equal power sharing relationship. A better situation is one where decision making power resides with a community organization such as the example of KHS given in this chapter. Such an approach has the advantage of helping resolve many legal and ethical issues, such as the important element of informed consent. Mapping is a means of preserving traditional knowledge. Many of the knowledge holders are elders who are the “living metadata” of Indigenous mapping exercises. The traditional knowledge of individual elders is often lost at their death. Preservation and archiving takes on new urgency in such circumstances. Technology is not an objective, value-free concept. In mapping with Indigenous communities, the most technologically elegant choice is not always the best choice. Many Indigenous communities like to see and control their own data, making concepts such as central computing capacity not acceptable for social rather than the technological reasons. Decentralized community centered approaches seem to work best. One shot Indigenous mapping are of limited value. A “Living Atlas” approach in which the community takes responsibility for the continuous updating of Atlas content has merit. Ease of use is key. Systems which depend upon content expertise with an “expert” between the community and the map are less sustainable. Systems which accommodate Indigenous languages are especially useful.

The GCRC has been working in partnership with Indigenous peoples for over 15 years. The results of this partnership have been mutually beneficial, especially in relation to the development of theory and practice of cybercartography and the development of the Nunaliit framework used to create the Atlases, and the demonstrated innovative benefits to communities that application of these to community needs have brought. This is an ongoing process and a mutual learning experience. A recent example of this process is the Clyde River Knowledge Atlas [https://clyderiveratlas.ca](https://clyderiveratlas.ca/). Jaypoody, Kautjk and Fox [[34]](#endnote-34) are using Nunaliit in an outstanding example of a community driven and controlled atlas.

In June 2019 the Senate of Canada released a ground breaking report entitled “Northern Lights: A wake up call for the future of Canada” [[35]](#endnote-35). The report does not consider mapping in particular but does look at research, traditional knowledge and the importance of community involvement and control. The report contains a number of recommendations for action by the Government of Canada. It proposes the wider adaptation of many of the approaches described in this chapter, already in use in mapping with Indigenous Peoples. Perhaps new approaches to mapping can lead to the more fundamental changes required in relationships with Indigenous Peoples worldwide.

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