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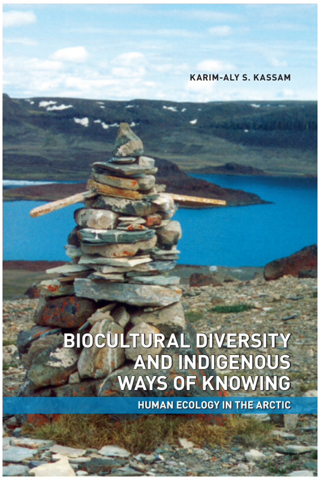

BIOCULTURAL DIVERSITY AND INDIGENOUS WAYS OF KNOWING: HUMAN ECOLOGY IN THE ARCTIC

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CHAPTER 5

"The Weather Is Going Under"– Human Ecology, *Phronesis*, and Climate Change in Wainright, Alaska, USA

We may grasp the nature of prudence [phronesis] if we consider what sort of people we call prudent.… Hence, when we think that Pericles and others like him are prudent, because they can envisage what is good for themselves and for people in general; we consider that this quality belongs to those who understand the management of households or states (Aristotle 2004: 150).

5.1. Introduction

Of the four objectives of this case study, the most important is an understanding of how the process of *living through* generates practical wisdom (*phronesis*). The second objective, related to the first, is a presentation of the value and relevance of indigenous knowledge on issues of societal concern such as climate change. The third objective is the articulation of a method which is best suited to gather and understand this knowledge. The final objective is the presentation of the human ecological implications of climate change.

Subsistence lifestyle inherently connects people to their environment, allowing them to observe discernible change. Therefore, indigenous knowledge about sea-ice, which is so important to subsistence livelihoods, has the potential to enrich and expand our collective understanding of climate change in the Arctic. Recent studies using documented personal observations based on indigenous knowledge indicate climatic variations on a regional basis (Krupnik and Jolly 2002; Magnuson 2000; Nichols et al. 2004; Reidlinger and Berkes 2001). Subsistence activities provide a practical foundation from which to undertake a study on climate change using both indigenous and scientific knowledge systems. Because sea-ice[1] is such a visible entity which is interwoven into the daily lives of polar communities, personal observation of ice phenology can help researchers understand climatic change.

In the context of Wainwright, Alaska, we have an unusual condition in that indigenous knowledge about sea-ice, gained through direct participation in Iñupiat subsistence activities, is relatively well documented (Nelson 1969; 1982). On the other hand, scientific knowledge about sea-ice is comparatively incomplete and can be made more rigorous by access to current as well as already documented indigenous knowledge. This has been recognized by researchers in the Arctic who have repeatedly pointed out that one of the values of utilizing indigenous knowledge arises from the incomplete nature of scientific knowledge (Berkes 1999; Cruikshank 2001; Kawagley 1995; Kawagley et al. 1998; Nelson 1969; Norton 2002; Reidlinger and Berkes 2001; Wenzel 1999). Furthermore, research on climate change is not simply driven by incomplete science, but by public desire for and participation in the process by indigenous Arctic communities. Some researchers have described research in Arctic environmental changes as a 'frontier' in polar science and public action (Krupnik and Jolly 2002).

Sea-ice conditions play a fundamental role in subsistence hunting activities of Wainwright. Harvesting of marine mammals establishes the baseline for research using sea-ice as an indicator of local climate change. This case study seeks to document sea-ice morphology and phenology based on observations by community members from Wainwright. The research on climate change was conceptualized on the basis of their subsistence lifestyle. With ice movement and because of it, there is an abundance of marine resources for harvest in the North Slope of Alaska. The residents of Wainwright are significantly dependent upon the fruits of sea for their nutritional needs (Braund 1993; Fuller and George 1999; Ivie and Schneider 1988; Kassam and the Wainwright Traditional Council 2001; Luton 1986; Nelson 1969; 1982). Along with the richness of the sea there are additionally special problems of safety and travel on open water and sea-ice. As a result, the Iñupiat have over successive generations developed detailed knowledge of the sea-ice environment and methods for interacting with it (Nelson 1969; 1982).

Wainwright, Alaska, is located 85 miles (136 kilometres)[2] southwest of Barrow at 70.59° north and 160.07° west, on the Chukchi Sea (see figure 5.1). The community is 480 kilometres north of the Arctic Circle. It is inhabited by a mix of *Kuugmiut* (people of the Kuk River) and *Utuqqaġmiut* (people of the Utuqqaq River). Both groups are Iñupiat. Wainwright, originally known as *Ulġuniq* by the Iñupiat, is one of eight communities belonging to the North Slope Borough, which acts as the political subdivision or municipal government for northwestern Alaska. The population of Wainwright is approximately 550 residents with 91 families (Kassam and the Wainwright Traditional Council 2001).

The effects of climate change in this small locality, when tabulated from indigenous knowledge and satellite photographs, have been shown to be significant. The micro-environmental changes occurring, documented by science and indigenous knowledge, are being repeated in the whole circumpolar region. This site-specific study points to the need for similar studies throughout the region and on other continents.

1. The starting point of this case study is the conceptual underpinnings and methodological process for the gathering of indigenous knowledge regarding sea-ice (section 5.2).

2. This is followed by a summary of the climate change–related local observation from previous human ecology research

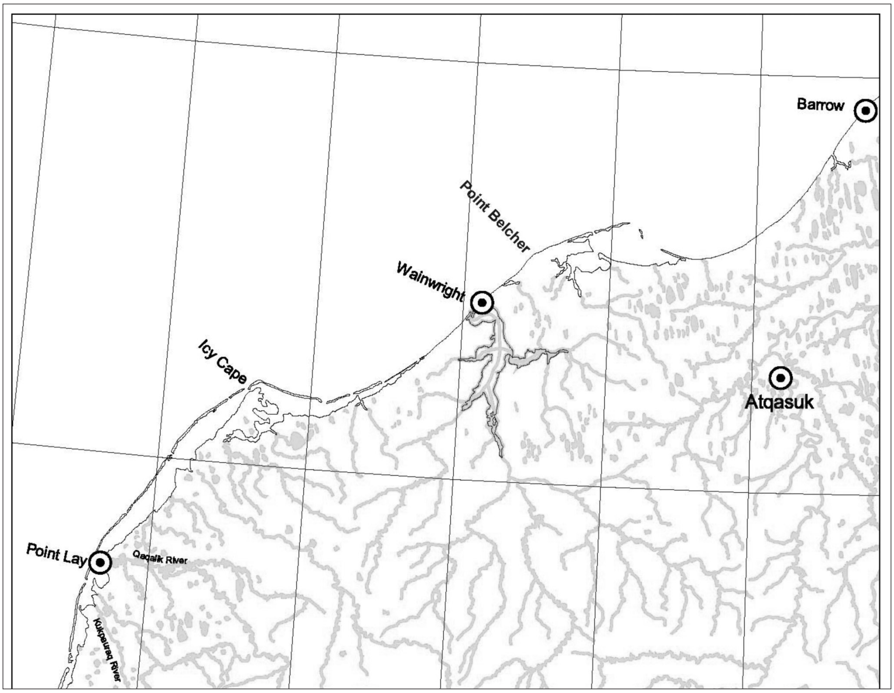

Figure 5.1: Map of Wainwright.

carried out in partnership with the community of Wainwright, Alaska (section 5.3).

3. This chapter presents research results relating to sea-ice phenology and morphology (section 5.4).

4. This chapter examines the human ecological implications of climate change as described by the community (section 5.5).

5. This chapter concludes with a discussion of the overall case study with respect to context-dependent knowledge (section 5.6).

5.2. An Approach to *Phronesis*

Community participation and action research elaborates knowing *how* in a way that is methodologically sound and necessary to investigate *phronesis* or practical wisdom. The information gathered through action research may be validated in a numbers of ways because validation is both an exercise in power and speaks to the credibility of the research. This section hopes to answer the question of how such research is best validated.

5.2.1. Phronesis Revisited

Knowledge from a human ecological point of view does not lie in the heads of individuals, but in the relations between them and their environment. Human ecology exemplifies the complex interconnectivity between the biological and cultural. Iñupiat human ecology provides spheres of contextually defined connectivity that enable knowing *how* one lives with and on sea-ice. In turn, this practical wisdom, or *phronesis*, sheds light on weather changes in Wainwright, Alaska. Learning is achieved in a context, which provides an explanation of connected patterns. These patterns are revealed through relationships such as those of the Iñupiat of Wainwright, Alaska, to sea-ice.

The geophysical location of Wainwright compared to other communities on the North Slope of Alaska speaks to context-dependent knowledge. One of the participants in the research, Homer Bodfish, explained: "The sea conditions between Barrow and Wainwright are very different. The reason for this is the 'U' shaped location of Wainwright from Icy Cape in the west to Point Belcher in the East." The village is located on a peninsula on the east side of the mouth of the Kuk River. Unlike Barrow or Point Hope, Wainwright is not located on a point. Therefore, ice movement in this region is different because it forms a concave arc moving NNE to SSW bounded by Icy Cape (*Qayiaqsiġivik*) approximately 50 miles (80 kilometres) to the southwest and Point Belcher (*Nunaġiaq*) 15 miles (24 kilometres) to the northeast (Nelson 1969: 35). As Wainwright is located on a shallow bight where the bottom drops gradually into the Chukchi sea, land-fast ice extends out several miles steadily as the winter progresses (Nelson 1969: 33). Because of its unique location, ice movement in the Wainwright area is affected equally by both the wind and current relative to other coastal communities on the North Slope. Therefore, knowledge of sea-ice movement for the purposes of subsistence hunting is distinct to Wainwright's coastal geography and gained through direct experience.

Knowing *how* is crucial to ecological problems resulting from climate change. It is noteworthy that the science of weather forecasting predates satellites, computers, and modern communications technologies, and it emerged from indigenous or local experiential knowledge. Hunting and gathering, agriculture, and maritime and overland travel for trade all required human societies to be able to forecast weather.

The method of research by applied scientists is pragmatic and best described as *praxis* (Greenwood and Levin 1998). The scientist first 'speculates' – that is, generates a hypothesis, and, second, makes observations or conducts experiments. Simultaneously, it is important to note that the hypothesis, while tentative, is arrived at by posing questions based on previous observations (Mayr 1982). The questions are posed within a particular social context and, therefore, are contingent. The process is neither purely deductive nor inductive; rather, it closely resembles knowing *how* (Berg 1995). The knowledge generated is context-specific, not based on absolutes and requires continuous testing. In essence there is a diversity of methods of gathering knowledge which involve observation, participation, and experimentation, all of which rely on learning *how*.

5.2.2. Community Participation and Action Research

The character of the knowledge (knowing *how*) determined the nature of research methodology employed in this study. Knowing *how* is gained through performance where the hunter is bodily and mentally active. Knowledge is both achieved and communicated through participation in partnership with the community, an essential element in enabling an understanding of Iñupiat experience of sea-ice. Meaningful community participation includes the involvement of the community in the planning of the research process, collecting and analyzing information, and utilizing the research results. In this way community participation is an active process in which community members are involved in influencing the direction as well as the execution of the research at all stages. The aim of action research is not simply the generation of a research product, but also the integration of the aspirations and priorities of the community at every stage.

This case study flows from action research on human ecology, which examined the relationships between Iñupiat of Wainwright and their environment: specifically, the relations between humans, other animals and plants, and their habitats. A total of fifty interviews were conducted in 1999. Twenty-two of the participants were female and twenty-eight were male. Their ages ranged from the early twenties to the late nineties. All participants except one, a young female, were currently or had been in the past hunters, fishers, and/or trappers. There were thirty-eight currently active hunters, fishers, or trappers among the participants. Approximately half of the participants were over the age of sixty and were considered 'elders,' all of whom had engaged or continued to engage in a subsistence lifestyle.

In the summer of 2000 when the results of the research were being presented to the Wainwright Traditional Council for validation, observations on climate variations, taken from interviews, were also noted. At the outset of the research, there had been no intention to study the impact of climatic changes at the local level, although weather changes were discussed as they affected harvesting and food consumption (Kassam and the Wainwright Traditional Council 2001: 9). As early as the 1980s, weather changes were perceptible to hunters as a result of a shift in the position and formation of leads in sea-ice, which was manifested in changing waterfowl behaviour in terms of feeding and landing locations (Nelson 1982: 108–9). It is not surprising that the intimate knowledge the Iñupiat have of their local ecosystems revealed perceptions by Wainwright community members of broad changes in the climate and, as a consequence, in animals. The leadership of the community requested that additional research be undertaken to explore Iñupiat knowledge of climate change to confirm the earlier research because of its importance to their subsistence activities. A total of fourteen new interviews were conducted with captains of traditional whaling crews and subsistence hunters who have an immediate and intimate empirical understanding of sea-ice conditions. These new interviews based on climate specific questions are the basis of this case study.

Action research is anchored in community participation. Its purpose is to produce practical knowledge gained from and returned to the community. Action research recognizes that such knowledge is revealed through participation rather than simply logic or observation (Dewey 1933; Feyerabend 2002; Greenwood and Levin 1998; Lewin 1951; Reason and Bradbury 2001). While recognizing the value of the outside 'expert,' this approach also values the practical wisdom or *phronesis* of local inhabitants. The actors in this form of knowledge production are socially diverse. In turn, the community is involved in the construction of its own knowledge (Gibbons et al. 1994). Action research methodology is central in determining validity of the research undertaken. Indigenous knowledge, in this case Iñupiat knowledge of sea-ice, is not merely data, but part of a greater social context (Cruikshank 2001).

5.2.3. Validity

Validity criteria in action research are as significant as in any other scientific activity because this type of research deals with matters that are complex and important to the lives of the Iñupiat, and eventually, to the wider human community. Just as in science, in action research validation of knowledge is community-based. In science, rigorous testing of the validity of propositions is determined on the basis of *communities of inquirers*, whereas in action research it takes its domain from *communities of social practice* (Argyris, Putnam, and Smith 1985). Through experimental methods and the peer review process inquirers rationally criticize each other's claims. Similarly, in action research the community, in this case, the Iñupiat hunters and traditional whaling captains, engage in public reflection on their observations. Public testing may result in potential disconfirmation of knowledge claims. Just as *communities of inquirers* constitute a base of knowledge experts, so do the subsistence hunters constitute knowledgeable experts (Kassam and Tettey 2003). While science tests the validity of knowledge generated in their *communities of inquirers* to check if the proposition is falsifiable, participatory research tests the knowledge generated through its usability (workabililty) for the communities it seeks to serve. This gives action research a strong pragmatic or practical underpinning (Argyris, Putnam, and Smith 1985; Greenwood and Levin 1998). In other words, is the knowledge given about sea-ice actually useful; does it work; can it be applied? This type of validity test is possible because the nature of the knowledge regarding sea-ice is primarily of the form of knowing *how* to undertake subsistence activities on sea-ice, and the ultimate test is survival.

After analysis of the additional interviews, the climate change interview results were presented to the community of Wainwright, Alaska, in the summer of 2001 for validation at an open meeting. Fourteen community members were present, ten who had participated in the interviews and four others who were among the leadership of the community and had an interest in the research. The validation session was held in two parts: before and after noon. Unlike the interviews that were conducted individually, the examination of research results was a group activity. Eight posters reflecting an analysis of the interviews with regards to wind and current patterns, sea-ice formation, pressure ridges, and leads illustrated by maps and notes were meticulously reviewed. In addition, satellite aperture radar (SAR) images for the period 1996 to 2000 were on hand and reviewed by community members present. Consensus on validity of information from the interviews undertaken occurred after discussion, clarification, and in some cases correction of data presented. New and relevant information was added as a result of this process. It was at this meeting of the group that the title of the case study was determined: "The weather is going under" – reflecting the deep anxiety community members were feeling from their increasing inability to anticipate changes in weather.

Finally, the penultimate draft of this chapter was reviewed by the Wainwright Traditional Council for accuracy of observations and analysis in the spring of 2004. The research results are compared and contrasted with earlier studies carried out by Nelson (1969; 1982) that provide valuable Iñupiat knowledge of sea-ice previously documented at Wainwright, Alaska, and with satellite aperture radar (SAR) images for the Wainwright coastal regions over a period of five years (1996 to 2000).

5.3. Previous Human Ecology Research

As noted earlier, the fifty interviews conducted for human ecology research provided the impetus for further research on variations in weather affecting Wainwright. Summarized below are eight observations made by hunters, fishers, and trappers in the community.

1. Many community members noted that there has been an increasingly observable warming trend over the last fifteen years.

2. Local observation indicated clear biological impacts on organisms arising from climatic change. A warmer and longer fall season affects the quality of fur found on animals such as wolves, wolverines, and foxes. Blair Patkotak, who hunts fur bearers, noted: "The quality of fox, wolverine, and wolf fur is much better in colder years." He observed that the guard hairs, which are the longer and more wiry strands, are not as long as they were ten or fifteen years ago. For instance, the guard hair on the hindquarter of a wolverine now ranges between four and six inches, where it once was considered normal for them to reach eleven inches. Winter conditions do not dramatically affect the fur quality, even if the winter is cold. The quality of fur is said to be directly affected by warmer autumn months.

3. Warmer fall and winter months also appear to affect the freeze-up of sea-ice around the region of Wainwright, Alaska. Participants in the research observed that freeze-up, which used to begin in October, is not taking place until December. Furthermore, when freeze-up does occur, the ice is not forming as thickly as it used to.

4. Climatic changes make subsistence harvesting activities potentially dangerous and have a direct impact on the ability of the hunter to harvest food. Figure 5.2 illustrates the range of harvest of foods for Wainwright. Specifically, the people of Wainwright continue to harvest a number of marine mammals: the bowhead and beluga whales, the bearded and ringed seals, and the walrus.

5. Safe harvesting of the bowhead whale requires calm weather and strong ice. Hunters must be aware of thin ice that may not support the weight of a bowhead whale as it

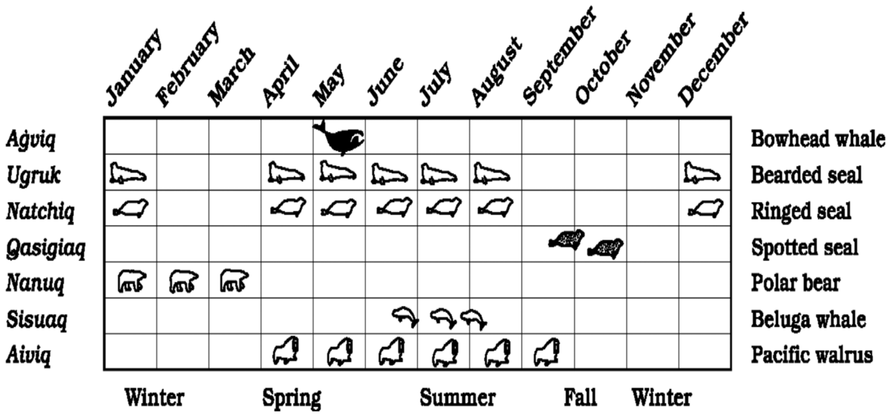

Figure 5.2: Marine Mammal Harvest Season.

is being pulled out of the water and up onto the ice with block and tackle. The bowhead harvesting season is from mid-April to early June, as the bowhead do not pass by the community during their fall migration. This reiterates the context-specific character of sea-ice phenology and subsistence hunting practices in Wainwright compared to a neighboring Iñupiat village like Barrow which undertakes harvesting of the bowhead whale in both spring and fall.

6. Strong and stable ice conditions are required for marine mammal harvesting. Hunters prefer to harpoon walruses, which tend to sink, on drifting floes and pans of ice after the breakup. Due to their size, they are usually butchered out on the ice anytime after mid-June through November. Although seals are not as heavy as walrus, the hunters also butcher *ugruk* (bearded seal) directly on the sea-ice after the hunt. Hunters take home only the usable portions of the *ugruk* leaving the remainder. This is a relatively more efficient method of butchering than taking the large seal back to the home of the hunter, provided that the sea-ice is solid and stable.

7. Late freeze-up also has an impact on the polar bear population, which is trapped on the land and appears to be starving. Community members are often forced to kill these bears when they come to the town seeking food as they pose a danger to the community. Several years back, a resident from the neighbouring village of Point Lay (to the West) was killed by a starving polar bear. In the summer of 2000 during research on indigenous knowledge of climate change, there were several sightings of polar bears stranded on land and one had to be killed because it ventured into the community. Examination of the bear indicated that it was starving.

8. An elder, aged sixty-two, noted that the tundra appears to be softening and melting. As a child, he remembered being able to dig only six inches deep into the ground. Now he can dig three feet into the ground.

As a result of these observations by community members about climatic factors, there was sufficient justification to warrant further investigation on subsistence harvesting and climate change through sea-ice conditions.

The next section provides the results of the fourteen additional interviews conducted specifically to document local observation of climate change in Wainwright, Alaska.

5.4. Human Ecology and Climate Change

In order to understand whether (knowing *that*) climate change is taking place, we must ask *how* the performance of tasks on sea-ice by the Iñupiat of Wainwright are being affected. In this section, two more objectives of this case study will be dealt with: namely, to observe *phronesis* in action and to illustrate the value of indigenous knowledge to issues of societal concern. Below we will summarize Iñupiat knowledge of ice formation, grounding of pressure of ridges, opening of leads in ice, and the dynamic and mutually reinforcing roles of winds and currents.

5.4.1. Ice Formation

It is said that previously, formation of slush ice in the Wainwright area began in late September or early October. Slush ice was then pushed offshore by the wind forming against the Arctic pack ice which was extending southward. The broad floes of the newly formed young ice extend towards the land with winds from the sea in October. In 1964, Nelson reported that ice hunting had begun by late November in Wainwright (1969: 11). Furthermore, in 1981 Nelson observed that formation of *tuvaq*, or land-fast ice, may vary and ice may not reach the shores of Wainwright until late November (1982: 2–4).

The talent the Iñupiat display in hunting marine birds and mammals is fundamentally linked to their knowledge of sea-ice. The presence of ice for the Iñupiaq brings the promise of game. Once the shore-fast ice has formed, the seasonal cycle of hunting may begin. Figure 5.3 illustrates the seasonal nature of harvesting of resources and their relative intensity. Furthermore, it indicates periods in which sea-ice may affect harvesting of a resource. While the figure does not show the presence of pans and floes of ice in late June through to September, they are essential for the harvesting of walrus and bearded seals.

At present, community members contend that within their lifetime they have witnessed significant change in ice formation. In the past, slush ice was present in September and shore-fast ice began forming in October. Billy Blair Patkotak,[3] an elder, noted that "fifteen years ago we could predict ice formation, we cannot do so now, the system is screwed up now." Over the last twenty-five years, ice formation, on average, has gradually moved later into the fall. Twelve of the fourteen interviewees gave specific information stating that they have noticed warmer weather conditions where freeze-up has shifted from mid or late September to late November or December. Barry Bodfish, an elder hunter, pointed out that shore-fast ice once began forming in September; however, at present people are still boating in late October and into November. In 2001, freeze-up (formation of shore-fast ice) did not occur until January 16. Late ice formation has been blamed for altering ice morphology, causing a negative impact on hunting and travelling in the coastal areas around Wainwright. Thirteen out of the fourteen interviewees stated that they have noticed the nature of sea-ice has changed

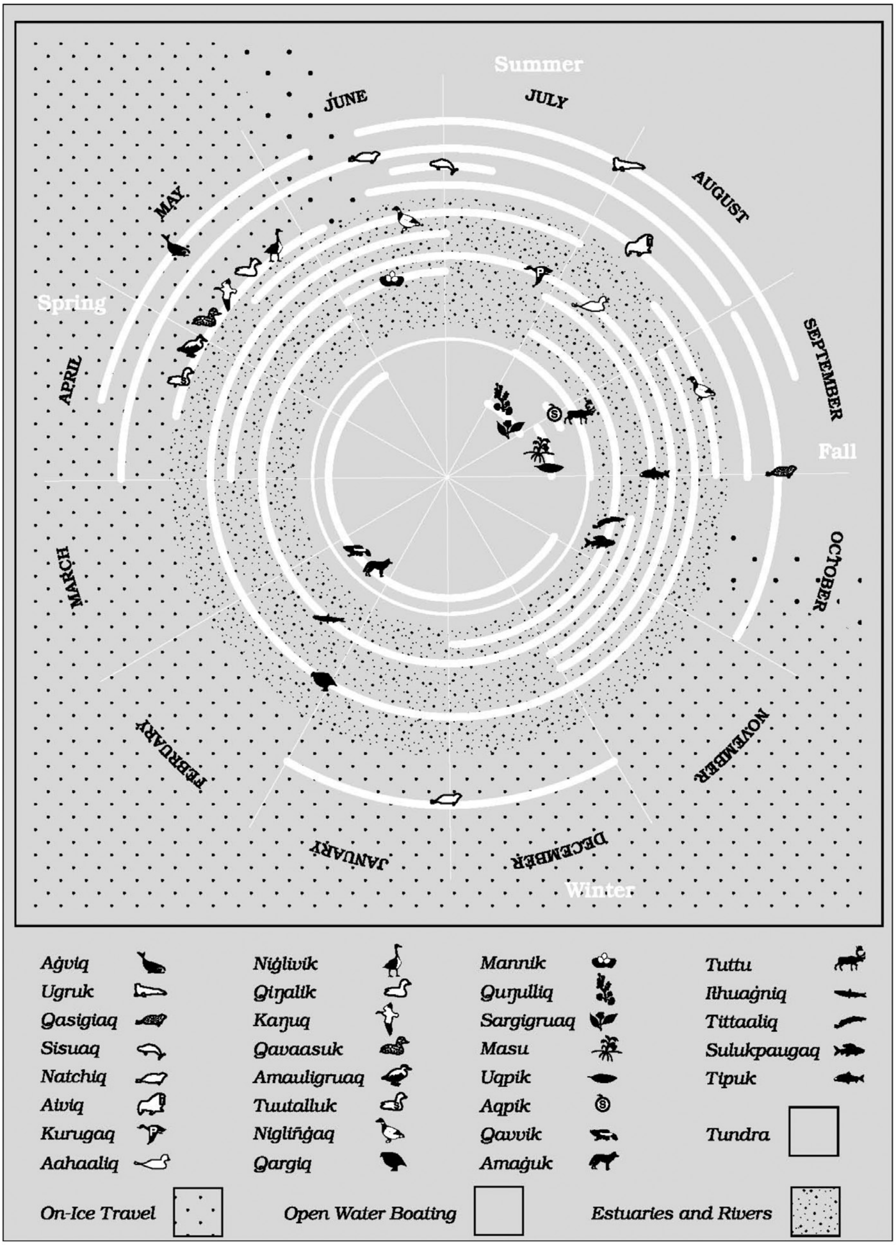

Figure 5.3: Seasonal Profile of Subsistence Harvesting in Wainwright, Alaska.

over the last twenty-five years. It is noteworthy that most hunting activities are not conducted in large groups, with the exception of subsistence whaling, which takes place with a crew of ten to twenty people. Therefore, the observations of these hunters reflect their individual experiences and as part of different subsistence whaling crews. In the past, ice was rough, thick, and robust, whereas currently, ice tends to be thinner, less likely to anchor to the shore and tends to "rot" (i.e., thaw) more rapidly in the spring. Billy Blair Patkotak noted that late ice formation and conditions such as rain in February are not allowing the ice to grow thick like it once did. Current research based on multidecadal scale of surface air temperature indicates a warmer summer in the Arctic which contributes to late ice formation. Furthermore, models based on this data predict declining sea-ice thickness as the warming trends continue (Johannessen et al. 2004). Thin, poorly developed ice makes subsistence activities more difficult. Tasks such as hauling a whale out of a lead up onto the ice have become burdensome and dangerous to whaling crews. Gene Aguvluk, a member of a whaling crew, explained that larger whales keep breaking through thin ice at present, whereas in the past crews rarely faced this problem because the ice was much thicker. Billy Nashoalook, an elder, confirmed that single year ice tends to "rot" quickly, resulting in concerns for safety of subsistence hunters. Overall, community participants in the research noted that the ice seems to be a lot more "damp" (wet) and it does not get very thick. They estimated that it does not get thicker than four feet. They explained that when snow falls onto the water and does not melt, the ideal condition for sea-ice formation has begun. The current and the wind then work together to push the snow together to form "young" ice in the fall. This "young" ice accumulates to form shore-fast ice.

Temperature is important to the formation of sea-ice. The north wind helps form slush-ice and the calm weather allows it to grow, thus making the ice stronger. In the past, cold prevailing winds from the north/northeast in the early fall, along with a current running parallel to the coast in a southerly direction, helped facilitate ice formation. Late fall would have south/southwesterly winds and a current out of the south, resulting in pressure ridge formation. At present there has been a reversal with southern winds prevailing in early fall and northeast winds dominating the late fall.

This altered pattern retards ice formation in the autumn, and once the ice does form, it tends to get forced out to sea before it can become solid shore-fast ice. The participants emphasized an increase in erratic weather patterns. They had not observed such variation in ice formation before, nor did they recall the presence of less robust (thinner) ice in the past.

5.4.2. Pressure Ridges

Pressure ridges are an important characteristic of sea-ice. They act as anchors, grounding shore-fast ice to the ocean floor in shallower areas. Pressure ridges allow for safe passage for hunters on the shore-fast side of the ridge even when the current is shifting. According to Nelson (1969: 67), at Point Belcher and Icy Cape the "ice piles heavily" due to the depth of the water and movement of the current. Furthermore, on the south side of Icy Cape, which is an area exposed to southerly storms, there is intense ice movement with very high and extensive ridge formation (Nelson 1982: 11). Nine of the community members interviewed stated that pressure ridges are smaller and fewer in number today, compared with the past. They noted that this change is particularly observable in the past five to six years. Community members noted that because of thinner ice, pressure ridges do not anchor to the ocean floor. Without pressure ridges anchoring sea-ice to the shore, ice can be easily carried out to sea by wind and current. This can be a very dangerous situation, explained Noah Phillips, because hunters can drift out to sea, creating an often life-threatening situation. George Agnasagga, a hunter, pointed out that once the pressure ridges form, the ice is safe landward of the ridge. The ice may move on the seaward side of the pressure ridge, but it is anchored solidly and is safe on the shoreward side. He explained that in order for large anchoring pressure ridges to form, there must be strong south/southwesterly winds coupled with a current out of the south in the late fall and early winter. This will force the ice to pile up along the shore. Without these two factors, large anchoring pressure ridges will not be created, as was the case in the spring of 2000. With little southerly wind over the winter (1999–2000), pressure ridges were few and poorly developed along the coast of Wainwright.

During validation of research results participants agreed that the wind and current dynamics for anchoring pressure ridges require a strong westerly to southwesterly wind and a current moving from southwest to northeast. The new irregularity of the weather makes the reliability of pressure ridges difficult to discern. This means that predicting weather conditions by the Iñupiat for subsistence activities becomes increasingly difficult.

5.4.3. Leads

The location of leads is directly related to the formation and location of pressure ridges. Leads are longitudinal openings in the ice that are formed on the seaward side of large pressure ridge. Leads form when winds and currents break the ice free from anchored shore-fast ice and move it outward into the ocean. The locations of leads normally change from year –to year as a result of wind and current patterns. Certainty in terms of the location of grounded ice is determined after leads have formed and closed several times. The most effective test to find the location of grounded ice and the safest leads is a storm that would normally shift the ice away. Therefore, the Iñupiat hunt on the landward side of the leads that run parallel to the coastline (1969: 15; Nelson 1982: 4). Leads begin as cracks in the ice. Not all cracks become leads. For hunters, fractures in the ice that are more or less perpendicular to the coast are considered safe for travel. However, ice on the seaward side that runs parallel to the coastline may easily break away from the shore-fast ice (Nelson 1969: 54).

Nelson reported that the northeast wind is most likely to create an open lead. Unlike the coast at Point Hope or Point Barrow, in Wainwright hunters have had to travel 10 to 20 miles (16 to 32 kilometres) from the shore to hunt for the bowhead whale. Sometimes hunters have travelled to Icy Cape to the southwest or Point Belcher to the northeast to take advantage of leads that remain open longer, are closer to the shore and have a greater abundance of whales (see figure 5.1). In May 1965, he observed that hunters in Wainwright went out 12 miles (19 kilometres) from the shore during the whaling season (1969: 39; Nelson 1982: 11–12). Billy Blair Patkotak stated that on average leads form 2 to 10 miles (3 to 16 kilometres) out in front of Wainwright. Currently the leads tend to be slightly closer to shore than they were in the past (20 to 30 years ago). The exact location of the leads does necessarily hinder subsistence activities. However, if the leads do not open or are too far from the shore, hunting may be hampered. Also, if pressure ridges do not anchor the ice or the ice is not robust around open leads, hunting activities can be hindered, as pointed out by Gene Aguvluk in the section on ice formation (5.3.1).

The current is from the south in the spring – that is, moving pack ice from the southwest to the northeast. The current in the fall shifts to the north – that is, moving pack ice from the northeast to the southwest, therefore, along the coast. As noted earlier, ice conditions in Wainwright differ from Barrow to the northeast and Point Hope to the southwest because Wainwright is located in a gulf between Point Belcher and Icy Cape. Ice break-up occurs at Blossom Shoal. High tide can break the ice without wind, only using the strength of the current. Whaling Captain Rossman Peetook explained: "In calm weather we have seen the lead open-up because the tide goes up and down, *katak*." Gregg Tagarook Sr., an elder, added: "On that day when the lead opens up we know that the North wind is going to blow."

Rossman Peetook explained that high tide with a southwest wind, that is, moving to the northeast, is called *Aunnaġruk*. Low tide with northeast wind, that is, moving to the southwest, is called *Nigiqpak*. When there is first high tide and then low tide, the ice can crack and form a lead. This is referred to as *katak*. At present leads are forming closer to the land. The thicker the shore-fast ice, the longer it can potentially stay in the spring. At present the shore-fast ice is not very robust. The wind and current are increasingly irregular, thereby affecting lead formation.

5.4.4. Winds and Currents

Both wind and current direction are central to discerning climatic changes in Wainwright. It is useful to review Nelson's research work documenting extensively the knowledge of Iñupiat hunters regarding sea-ice formation and movement as it relates to wind and current direction. Nelson is very clear that this knowledge is entirely gathered from the Iñupiat of Wainwright and no other external or published sources were consulted (1969: 391–397; Nelson 1982: 41).

Reiterating that knowledge about weather and sea-ice morphology is context-specific, Nelson's research confirms that unlike Point Barrow or

Point Hope, where the current can shift heavy winter ice, in Wainwright both the current and wind must combine to move shore-fast ice (Nelson 1969: 35). However, in warmer months the current plays a greater role (Nelson 1969: 85). The current in the winter moves along the same direction as the wind and in the summer flows from the south (Nelson 1969: 39). Currents shift before an approaching change in the wind. When there is a slight west or southwest wind, a hunter will first test for the direction of the current before travelling far out onto the ice. A slow northeast current is a warning not to go beyond the safety of land-fast ice (Nelson 1969: 37). In the spring, the warm current, the bright sunlight, and mild temperatures combine to melt the ice. By June these conditions cut away at the shore-fast ice and signal the end of the whale-hunting season (Nelson 1982: 6–7).

In general an offshore wind moves ice out to sea and an onshore wind brings it onto the coast of Wainwright. Current direction, however, may lessen the influence of wind on ice movement. The south, southeast, east, and northeast winds move the ice seaward. The north, northwest, west, and southwest wind move the ice landward to Wainwright. The winds affect the current. Winds from the south, southeast, and southwest cause a southerly current moving ice offshore along the coast of Wainwright. Winds from the west, northwest, north, northeast, and east cause a northerly current moving ice onshore along the coast of Wainwright. Nelson reports that this "correlation is most pronounced" in the winter months from November to April. In the spring and summer from May to August the current runs from the south to southeast. Finally, in the autumn, from August to November, it runs from north to northeast except in the case of occasional southerly storms where it is temporarily reversed (1982: 7–8).

Wind from the northeast, which is the usual direction of winter storms, causes the pack ice to drift seaward, thereby opening cracks and leads along the coast of Wainwright. While this is dangerous for ice travel, it is favourable for seal hunters who hunt along the landward side of the lead, especially when the northeast wind is moderate, keeping the lead open. In the late spring and summer, when the sea-ice moves much more readily, this wind is decidedly more dangerous. The Iñupiat hunters are very careful not to take unnecessary risks in travelling across unsafe sea-ice. Billy Blair Patkotak illustrates the significance of knowing *how* to traverse sea-ice: "When the ice is formed good and solid, before you go out too far, 3 to 4 miles (5 to 6 kilometres), be sure to make a hole in the ice and determine which way the current is flowing. If the current is moving away from the shore, do not go far. If the current is moving toward the shore, go as far as you want to go. In a west wind you go and with an east wind you be careful. When it turns warm in January or February on sea-ice, go home because a storm is coming."

Current direction may be determined by first digging a hole into the ice, widening a crack or using an open lead. Then a hunter may throw in an object, like a piece of ice, and trace the direction in which it is swept. Occasionally, hunting may take place on the seaward side of the pressure ridges. In such a situation, hunters carefully watch current and weather conditions as they venture beyond the solidly grounded ice (Nelson 1969: 34). If a crack has appeared behind a hunter and it has not widened to prevent him from crossing, he will check the direction of the flow of the current by tossing a piece of ice into the water. If a current is from the north he will move south, and if the current is from the south he will move north on the ice. There is safety in travelling down current because ice that moves parallel to the coast of Wainwright will often remain in contact with shore-fast ice pilling into Icy Cape to the southwest or Point Belcher to the northeast (Nelson 1969: 58).

In the cold months, the north and east winds lower tides, thereby grounding shore-fast ice. A modest southeast wind accompanied by a south or southwest current holds the pack against the shore-fast ice. However, a powerful southeast gale in the spring can open wide leads. Hunters explain that this wind can blow shore-fast ice away as accompanying tides lift the grounded ice from the bottom along the coast of Wainwright. Onshore winds such as those from the south, southwest, west, and northwest move the pack ice and hold it firmly against the shore-fast ice along Wainwright's coast. However, this may differ at Icy Cape, where the ice may move and open leads under these conditions. In the spring and summer, these winds allow to the hunters to safely venture far out onto the ice in search of seals (Nelson 1969: 35–37). Observation of wind direction in the spring and summer is key in determining movement of ice packs because this movement relates to the availability of marine birds and mammals (Nelson 1969: 41).

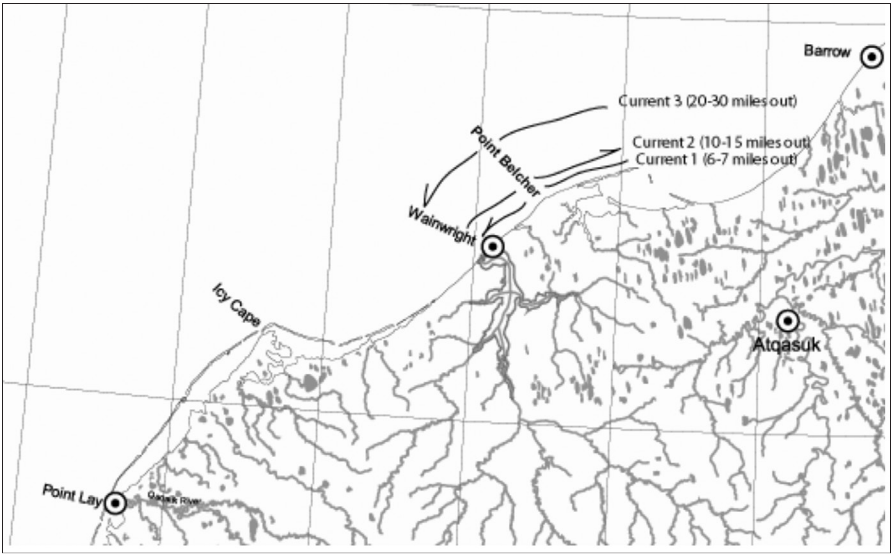

Figure 5.4: Three Currents Present at Wainwright, Alaska.

Both wind and current direction are important variables in ice formation and movement. As previously mentioned, based on past experience, early fall used to consistently have a north/northeasterly wind with a northern current, creating a cold environment, thus allowing ice formation to begin. Late fall used to be dominated by a south/southwesterly wind and a southern current, forcing the ice against the land in order to create large anchoring pressure ridges. At present, weather such as southerly winds in early fall and northeast winds in late fall retard and damage ice formation patterns. For example, in late fall a northeast wind forces the young ice out to sea before it can become solid shore-fast ice.

The community members involved in spring whaling stated that the spring winds must be out of the north/northeast and a current out of the north to force the pack ice offshore in order to open the leads. It was also noted that if one of these variables (wind or current) is diminished or is not present, ice morphology and dynamics will be altered so as to have a direct impact on subsistence hunting. Charles Nayakik, an elder and experienced hunter, remembers when calm weather and weak currents did not open the leads and his family almost ran out of food, because they were unable to hunt the animals that congregate around open water.

According to Barry Bodfish, an elder with considerable experience of hunting on sea-ice in the areas around Wainwright, there are three currents running parallel to the coast (see figure 5.4). When the three currents are balanced, the pack ice stays close to the shore, allowing for safe travel and subsistence hunting, around open leads. However, approximately every twenty years on a cyclical basis the first current (6 to 7 miles or 10 to 11 kilometres out) and the second current (10 to 15 miles or 16 to 24 kilometres out) weaken. Simultaneously, the third current (20 to 30 miles or 32 to 48 kilometres out) strengthens, regardless of wind direction. This current pattern "sucks" the pack ice far out into the ocean, delaying spring hunting activities (such as walrus and seals) until the summer or even early fall. The pack ice will return only when the two currents closer to the shore regain their original strength. When the south wind is blowing, the first current is stronger and the third current is weaker. While Nelson in his documentation of Iñupiat knowledge regarding winds and currents does not make any reference to the existence of three simultaneously acting currents, he does indicate that it is difficult to judge current direction in the summer months because of eddies and counter currents along the edge of shore-fast ice or leads. Furthermore, surface currents may differ from subsurface currents (1969: 49). These various currents along the coast of Wainwright have a direct impact on the formation of sea-ice and its morphology.

5.4.5. Satellite Images

In addition to the research conducted with participants in the community of Wainwright, additional assistance was available from the North Slope Borough's Geographic Information Systems division, which helped to access and interpret satellite imagery. Synthetic Aperture Radar (SAR) images were used to complement information collected. For each year from 1996 to 2000, a total of five years, one image per month was collected from April to December for a total of nine months of the year. Keeping in mind the expenses associated with accessing each of these images, nine months out of the yearly seasonal calendar of subsistence activities seemed reasonable. Depending upon the availability of the SAR images, the pictures were taken roughly a month apart. While these images are only two-dimensional and do not portray the dynamic quality of the knowledge the Iñupiat have of sea-ice conditions, collectively they suggest trends.

Even though the SAR images do not provide information on the quality of pack-ice or the robustness of shore-fast ice and its relationship to ridges, they indicated that the heavy pack ice formed with shore-fast ice by mid-December. Until November, the area around Wainwright is characterized by offshore pack ice and young ice forming along the coast. The only exception is the image for December 2000, in which pack ice is still offshore, there is open water, and shore-fast ice did not form until January 2001. Images for spring for the five years indicated smaller open leads in April in front of the village of Wainwright, and by June large leads extending as far northeast as Point Belcher or the Village and widening beyond Icy Cape to the southwest. As the leads progress to the southwest of Wainwright they tend to get larger. This corroborates what the Iñupiat have already stated, that in the spring and early summer the current is from the south moving the pack ice from the southwest to the northeast. By July the SAR images indicated that there is open water around the coastal area of Wainwright. The SAR images show that indeed ice formation along the coast of Wainwright is now delayed as community members maintain. Furthermore, the images suggest that there is swift decay of shore-fast ice as the Iñupiat hunters contend.

When indigenous knowledge of the local context is combined with SAR data, both the community and researchers have a deeper understanding of natural phenomena such as sea-ice formation and variation in weather. However, SAR data alone is limited because it does not provide detailed information that links movements of currents and wind patterns along the coast of Wainwright. This knowledge is best gained from those who engage in contemporary subsistence living. In comparison to satellite images, Iñupiat knowledge of sea-ice is cumulative and continuous, based on a culture of hunting and gathering, whereas SAR data, while valuable, are episodic, based on access and availability of technology (see table 5.1). Iñupiat knowledge is local whilst SAR imagery is global. In other words, Iñupiat knowledge is more intimate with the land and context-specific in contrast to SAR data, which provides a macro-perspective. As a result, Iñupiat knowledge is rich in detail about sea-ice currents and wind patterns whereas SAR images are superficial, giving information as to ice surface. Because of the distance from which the image is taken and the nature of the technology, SAR data are static while indigenous knowledge provided by hunters is dynamic, illustrating a complex interplay of factors affecting sea-ice formation. Validation of Iñupiat knowledge is gained from a community of practitioners, whilst validation of SAR images is obtained through a community of experts. Iñupiat knowledge is based on knowing *how* and memory, and in contrast SAR images are based on knowing *that* and technology.

Table 5.1: Contrasting Characteristics of Iñupiat knowledge and SAR Images

Iñupiat Knowledge	**SAR Images**
Cumulative	Episodic
Local	Global
Rich in detail	Superficial
Dynamic	Static
Validation by community of practitioners	Validation by community of experts
Obtained by knowing *how*	Obtained by knowing *that*

The comparison of Iñupiat knowledge of sea-ice to SAR imagery is not intended to diminish the value of a particular scientific technological approach to investigation of climate change; rather the aim is to show the value of indigenous knowledge and the usefulness of both when the knowledge systems are combined. The scientific and indigenous categories are not mutually exclusive in the contemporary Arctic, as each informs the other in the day-to-day life of the Iñupiat.

Additional prospects for further research may also include a more detailed study of satellite images taken at regular intervals to reflect the dynamic movement of sea-ice. A valuable exercise may include participation of indigenous knowledge holders in the interpretation of satellite imagery. It should be noted that this satellite imagery is not ordinarily graphed for reasons of climatic change or indigenous human ecology. However, when interpreted with a human ecological lens and combined with indigenous knowledge, it becomes extremely valuable in understanding change.

5.5. Human Ecological Impacts

This section explores the human ecological implications of climate change. Climatic change in the region of Wainwright reveals three interconnected impacts on the human ecology of the area: (1) concern for the safety of hunters resulting from erratic weather conditions; (2) its implications for subsistence activities; and (3) the bearing these changes will have on the cultural system and social structure of the community.

The most immediate impact of climatic change in Wainwright is safety for subsistence hunters. Gene Aguvluk and Terry Tagarook stated that the best conditions for whaling occur when the prevailing winds are north/northeasterly. Such conditions will force the ice offshore, opening the leads where whales can surface. At this time of year, the current can be either from the north (which will help hold the lead open) or from the south (which will force the lead closed). Billy Blair Patkotak states that the east wind is what opens the lead, because it forces the ice directly offshore.

A spring with erratic winds or a lack of east wind can result in difficulties for whaling crews, as leads will not remain open. Barry Bodfish noted that the spring whaling harvest has not really been greatly effected by deteriorating ice conditions over the last twenty-five years. However, he said whale migration patterns have been altered in relation to the ice conditions. Even though whales are still obtainable off the coast of Wainwright, hunters face a problem that was previously not present. Currently, as Gene Aguvluk pointed out, ice conditions have deteriorated to the point where hunters have to search for ice that is robust enough to support the weight of a harvested whale.

The second implication of climate change is the viability of subsistence activities on sea-ice. The people of Wainwright are keen observers of the behaviour patterns of bowhead and beluga whales, seals, and walruses and their interaction with sea-ice. They know the importance of solid and stable ice conditions and they know that the ice is thinner than it used to be and how this impacts on their ability to harvest marine mammals safely. North/northeast wind patterns in the late autumn retard shore-fast ice formation, which in turn affects the formation of pressure ridges and the necessary leads for harvesting whales in the spring. The loss of ability to hunt marine mammals in safety may not only result in increasing accidents and loss of life on sea-ice, but may put greater pressure on harvesting of terrestrial mammals to compensate for food sources by the community. Furthermore, there may be increased pressure on other animal species that marine mammals feed upon as populations increase. Finally, marine mammal calving and migration patterns may be dramatically affected.

For the community, one issue prevails: the warming trend needs to be studied closely. The people of Wainwright have clearly indicated their concern for this erratic weather. In the words of Raymond Aguvluk, "Maybe next year we won't see ice." Iñupiat knowledge of ice phenology and morphology is a characterized by knowing *how*. This mode of knowledge enables hunters to be aware of both details and uncertainties and it is based on a relatively continuous transfer of knowledge from one generation to the next. As its objective, their knowledge does not aim to shape or control the environment but seeks the intimacy of existing within it through participation. This means having the ability to deal with dynamic ice conditions. However, the erratic weather situation around coastal Wainwright is a source of stress because it creates a disjunction, a fissure in the direct relationship between the Iñupiat and their habitat as they have known it. The implications of this type of instability and consequential anxiety in a subsistence hunting culture are difficult to assess beyond initial concerns of safety and travel on sea-ice. The loss of the power to predict climatic behaviour by the Iñupiat may lead to a debilitating anxiety that has profound effects on subsistence hunting practices, nutrition, and socio-cultural institutions. This case suggests that a study needs to be undertaken to assess the impact and implications of stress experienced by subsistence communities like Wainwright as a result of climate change. An examination of coping practices and adaptation may not only contribute to general knowledge of human dimensions of climate change, but more importantly, be useful to northern communities and their survival.

The third potential impact of climatic change in the region is that the combined effects of loss of safety on sea-ice and disturbance in subsistence hunting of marine mammals and birds may contribute to conflict between the cultural system and social structure of the community. As illustrated in chapter 2 (section 2.7.2) and demonstrated in chapter 4, human ecological

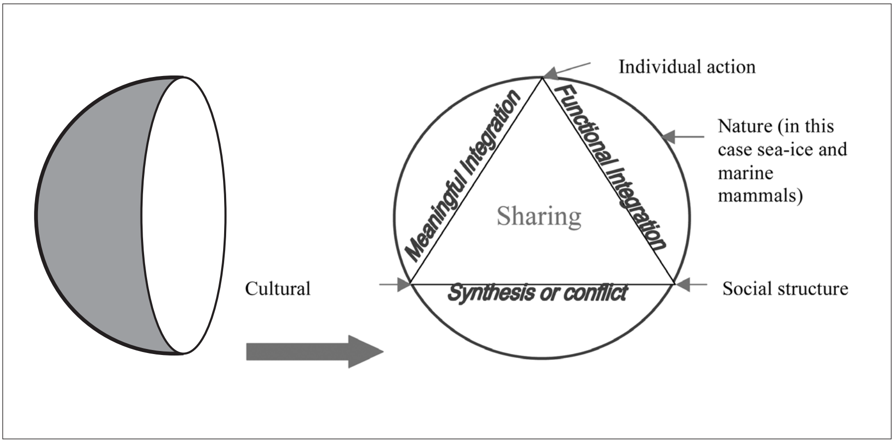

Figure 5.5: Dissection of Human Ecological Relations.

relations are dependent on a cultural system of symbols, values, and beliefs. Sharing, manifested, for instance, in the social context of the *Nalukataq* festival, is a fundamental value. If sea-ice conditions continue to deteriorate to the point where subsistence activities can no longer be carried out in the way they have been, socio-cultural impact may be devastating to the fabric of the community. Figure 5.5 illustrates the dynamic and deep interconnectivity between nature, culture, social structure, and individual actions in human ecological relations. A potential conflict arises when individuals are unable to integrate an important cultural value like sharing into their social action.

Historical evidence clearly indicates that the value of sharing has a deep resonance with, and a common thread linking the subsistence cultural system to, its social structure. The value of sharing has sustained human ecological relations of the Inuit of Ulukhaktok (chapter 4) or the Iñupiat of Wainwright in periods of dramatic socio-cultural upheaval. However, climatic variation may diminish the capacity of communities to be resilient. Human agency also has upper limits defined by its physical, cultural, and biological factors. In short, one needs *all* the parts in order to tinker.

Is the current climatic variation a challenge to sharing that can be overcome or will it result in a deterioration or modification of this fundamental value? Such understanding generated by action research could help the community's resilience. The stress study suggested in this chapter would be the beginning of undertaking the severity of the challenge.

5.6. Discussion

Knowledge at its point of generation is context-dependent. In order to achieve the four objectives of this case study: (1) to view *phronesis* in action; (2) to illustrate the value of indigenous knowledge in the study of climate change; (3) to suggest a process ideally suited to gather and understand this knowledge; and (4) to examine the human ecological implications of climate change, research had to be specific to the context of Wainwright, Alaska. In other words, in order ask *whether* climate change is taking place in the region of Wainwright, Alaska we had to examine *how* the performance of subsistence activities on sea-ice is being affected. Therefore, the case study has focused on Iñupiat observations of sea-ice.

This case study represents the movement from knowing *how* to learning *how* to knowing *that*. Knowing *how*, in this case, is represented by Iñupiat human ecological relations. Learning *how* is characterized by the research carried out by Nelson (1969; 1982) and this study. Knowing *that* are the research results (including the SAR data) which were then reviewed by a community of practitioners. It is an example of *phronesis*, the knowledge of *how* to secure the ends of human life. As such, *phronesis* is not a state of knowledge, but a dynamic process within a framework of human ecological relations. This case reveals that *phronesis* is firmly grounded in an ethical framework. The value of sharing was the objective end of the informed process of *phronesis*. This humanitarian and participatory conception of knowledge, which is why action research may have an immediate local impact on the community where it is conducted. Its impacts are derived from its inclusive methodology and its community oriented practical objectives.

The research in Wainwright is yet another indication that the nature and culture dichotomy does not exist in the context of indigenous societies of

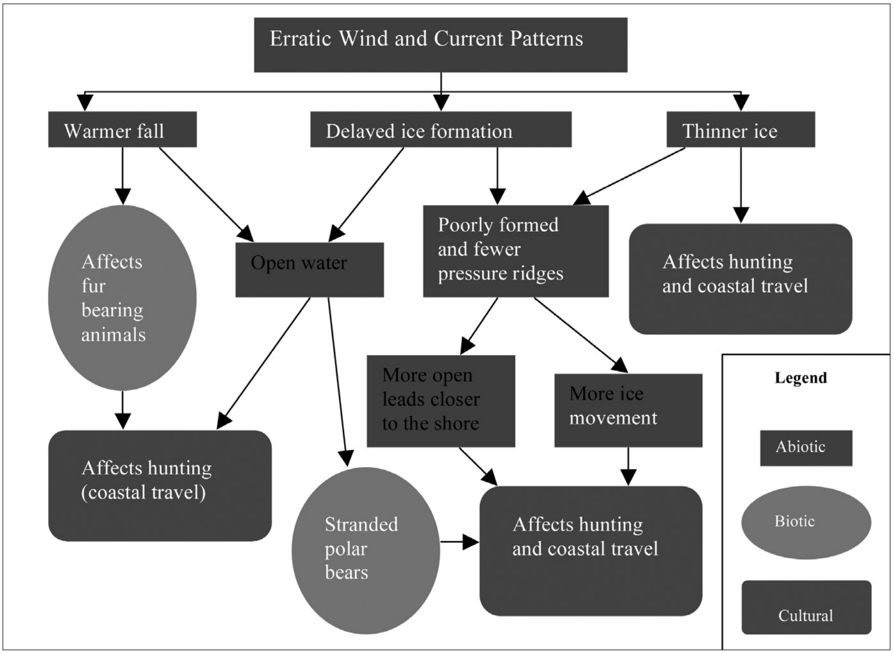

Figure 5.6: Human Ecological Relations (Abiotic, biotic, cultural) and Climate Change[4]

the Arctic. Figure 5.6 summarizes the dynamic human ecological relations resulting from the research on climatic variation in Wainwright, Alaska. In spite of the limitations of two dimensions and bound by causal representations, it nonetheless displays the complex interconnectivity of culture and nature.

Even though there is considerable evidence that there is climate change underway in Arctic environs with predictions of dramatic warming trends (Comiso 2003; Duerden 2004; Johannessen et al. 2004), the Wainwright research is not oriented towards an assertion that global climate change is underway. Rather it asserts that there are significant changes in the coastal weather of Wainwright, Alaska, that have a direct impact on the safety of the Iñupiat and the survival of their culture. This research does inform research on global climate change, but it does not directly address the subject or form conclusions about it because global climate change is based on worldwide averages and synoptic generalizations. At the macro-level of abstraction, there will always be debate, exceptions and therefore, uncertainty (Duerden 2004), whereas, the information related to changing weather patterns in Wainwright, Alaska, is specific, concrete, and embedded in human experience. Research indicates that climatic changes are being experienced along the coast of Wainwright, and this has immediate implications for the nutritional and social needs of the Iñupiat.

Applied research aided by indigenous knowledge and community participation is essential to understanding context-specific weather changes that manifest themselves in a global pattern. Similar research in other western Arctic communities confirms changes related to sea-ice formation and robustness. However, particular factors such as wind and current patterns may differ (Nichols et al. 2004). This indicates that there is a dynamic and complex interplay of geography, ecology, and culture. Concerted efforts to link further research, taking into account context-specific events across a wide number of circumpolar subsistence hunting communities, can contribute to a thorough understanding of climate change in the region as a whole. This would involve a major, sustained (multi-year) trans-Arctic and even circumpolar action research project. Using human ecology values, the project would include many communities, four or five countries, and a large number of researchers. Such research is not impossible, but it would be costly in the short term. However, the actual and practical long-run benefits would far outweigh the costs.

The purpose of this case study is to acknowledge the relevance of indigenous knowledge in the twenty-first century. This case study illustrates that northern research breaks through disciplinary boundaries. It speaks to the value of the knowledge generated from Iñupiat subsistence hunters related to sea-ice. The community of experts includes the community of practitioners, namely subsistence hunters who are most affected by climatic change. Addressing current research issues in the north requires not only interaction between the biological, physical, and social sciences, but also indigenous knowledge. Iñupiat knowledge of sea-ice is embedded in their cultural experience of subsistence hunting. It arises from knowing *how* to live on and derive a living from sea-ice. In this sense, this type of community-initiated and directed research extends the boundaries of interdisciplinarity to include indigenous knowledge systems. It is a collaborative process where diffusion of knowledge is primarily achieved through participation. Thus, generation of knowledge, like understanding sea-ice and climate change in Wainwright, reflects actors that are as socially diverse as hunters and scientists.

Climate change researchers and modellers decry the lack of *in situ* data (Comiso 2003). Poor data on sea-ice thickness is a clear example (Johannessen et al. 2004). The challenge remains for scientists and modellers to work with subsistence hunters to develop mechanisms utilizing indigenous knowledge, much as the Galilean revolution in science depended upon and employed the knowledge of craftsmen. Indeed, there are limitations to indigenous knowledge as there are with any knowledge system, but the practical and effective use of indigenous knowledge in climate change modelling goes relatively unexplored. The human ecological action research approach has not been utilized over a broad area. Extrapolation from Wainwright indigenous knowledge cannot be done even to a community like Barrow, Alaska, a mere 136 kilometres to the northeast on the same coast and in the same state. Since extrapolation is problematic, the pooling of dozens, if not hundreds, of such studies would be the only way to map the situation in the circumpolar region.