

The Steel Dog in the Canadian Arctic: A Historical Case Study of Technological Change

Eric Hoshang Pavri, University of Arizona

Abstract: During the “Snowmobile Revolution” of the late 1960s, the snowmobile largely supplanted the dog team as the main form of transport in the Canadian Arctic. This essay draws from historical and ethnographic sources to investigate practical advantages and disadvantages to adoption of the new technology, and then considers whether this episode of rapid technological change resulted in “cultural loss” in Arctic communities. While it is clear that widespread adoption of the snowmobile technological complex (machines, fuel, tools, skills, knowledge) caused significant changes in life in the Far North, it also appears that the meanings and values associated with traditional subsistence hunting were generally not lost, and in some cases were reinforced during this period of technological transition. Finally, drawing on various academic traditions such as the Social Construction of Technology school, ecological models of convergent cycles, postmodern critiques of modernization and development, and the appropriate technology movement, the essay then questions simplistic notions of cultural loss by considering the common evolution of culture and technology.

In the latter half of the 1960s, snowmobiles came into widespread use in the North American Arctic, largely supplanting dog teams as the main form of transportation for households of the region during the long winter season. Reviewing this particular episode of technological change serves as an entry point to examining larger social science questions about the role of technology in human societies, particularly as related to processes of modernization and development outside of the world’s centers of power and wealth.

Much social science research has focused on processes of technology transfer, promotion, or adoption in those nations commonly designated as “Third World” or “developing”. At the same time, however, within countries granted “First World” status there exist elements of the population that are

marginalized in terms of access to political and economic power. Often indigenous, these communities, together with many indigenous populations excluded from circles of power in nations of the “periphery”, comprise what is sometimes termed the “Fourth World” (Manuel and Posluns 1974, Ouellette 2002, Sider and Dombrowski 2001). This essay operates under the assumption that examining processes of technological change among indigenous communities in developed nations is useful to understanding similar processes in developing nations, since many of the structural relations of politics and economics – such as widespread material poverty, the general lack of input into decision-making processes, a history of resource extraction through colonization, and exclusion from the benefits of those resources – are common to both types of situation. This does not, however, imply that generalizations about technological change across cultures and regions are analytically adequate in themselves; rather, they must be derived from (and evaluated in light of) ethnographic and historical case studies. Analysis of processes of societal change must be grounded in specific “real life” examples, situations that play out in local political economic contexts, themselves created out of locally-specific histories¹. This essay, in order to approach larger questions of technological change, thus takes as its subject what has been termed the “Snowmobile Revolution” of the 1960s and 1970s in the Canadian Arctic.

TECHNOLOGY AND CULTURAL LOSS

Although he adopts a more nuanced perspective in his own writings about other technologies, George Wenzel has described the widespread perception that the increasing use of

¹ Recent theoretical approaches in anthropology have emphasized not only that “ideational” aspects of culture must be understood in specific material contexts (Wolf 1999, Smith 1999), but also that such contexts are profoundly influenced by historical processes (Wolf 1982, Dombrowski 2001, Comaroff and Comaroff 1992).

snowmobiles by Arctic peoples represented yet another cultural “loss” at the hands of expanding Western ideologies and lifestyles (Wenzel 1986: 75). It is worth noting that such warnings about cultural loss, common in scholarly critiques of the development field and the promotion of technologies, indeed provide a necessary check to the often uncritical embrace of “modernization” and “progress” by funding agencies and government officials. Arunoday Saha (1998) for example, has argued persuasively that technology must be seen as a subsystem of a larger cultural system including ideas and norms, and that the promotion of Western technologies is inexorably bound with the desire to control nature to serve human needs, with a reliance on reason to comprehend the world and solve problems, with an emphasis on individualism and improvement, and with an acceptance of individual happiness as the supreme good. Other scholars of the “social construction of technology” school similarly argue that technology cannot be usefully considered if extracted from holistic analysis of the economy, ideology, and even the foundational myths of a society (Bijker, Hughes, and Pinch 1987; Nye 2003). The basic lesson of this scholarly tradition is that technology is value-laden and that values and meaning in turn emerge from how technology enables human beings to interact with their environment – ideas that can be partially traced back to the writings of Marx. Technology is intimately related to how we perceive and manipulate our world, and the widespread adoption of a new technological complex can thus be expected to result in the loss of values and meanings associated with the old complex. This perspective is the basis for the association of technological change with cultural loss, particularly in regards to people whose exclusion from political and economic power gives them less of a say about what is worth “saving”.

When we adopt new technologies our lives change and often our ways of thinking and living are fundamentally altered. Languages may go extinct, neighbors may no longer work

together bring in harvests, hunters' stories that teach respect for the living world may be forgotten -- cultural loss is not imaginary. That which is lost or degraded as a result of modernization is often all too real. In the Arctic of the late 1960s, however, anthropological accounts from the period reveal a more complex picture. Although the introduction of the snow machine² certainly brought about drastic changes in livelihood strategies and other aspects of everyday life, this essay questions any simplistic assumption that the replacement of dog teams by snowmobiles necessarily resulted in a cultural diminishment of Arctic communities.

To do so, it first briefly reviews the historical context in which the snowmobile first became adopted in the Arctic, discusses the manner of its adoption, and then considers some of the practical advantages and disadvantages of snowmobile use compared to dog-team traction. After examining how the introduction of snow machines affected specific aspects of Arctic life, the essay situates this particular case study within various scholarly perspectives on technology, including those of economic modernization theory, postmodern critiques of development, theories of dependency, and the literature and practices of the field of appropriate technology. Finally, the concept of "intermediate technology" is introduced and the utility of its application as a descriptive term is considered. Such analysis of the lexicon of development is more than scholarly hand-waving. As the writing of postmodern scholars has usefully reminded the field of anthropology, discourse powerfully structures and limits what can be thought, and the words that exist to describe the world thus profoundly influence what actions are conceivable, desirable, and eventually put into practice (Foucault 1971,1973). In the words of one scholar, "the

² This essay employs the terms "snowmobile", "snow machine", and "Ski-doo" interchangeably. Although terminology varies by region, all of these names are commonly used by both Arctic inhabitants and anthropologists to refer to this form of transport (Hall 1971, Nelson 1983, and Smith 1972).

thoughts and actions of ‘development’ bureaucrats are powerfully shaped by the world of acceptable statements and utterances within which they live” (Ferguson 1990: 400). In an age where decisions regarding the allocation of billions of dollars shape projects and policies that impact much of the world’s population, critical examination of the terms used in “development” and in the promotion of technologies is more than a trivial academic exercise.

LIMITS ON THE SCOPE OF STUDY

This discussion concentrates on the years 1965-1970, the period of initial widespread adoption of the snowmobile by Arctic native peoples, although other research has focused on more recent changes. For example, George Wenzel has written extensively about the detrimental effects of the 1983 European seal ban on Arctic hunters (1986, 1989, 1991, 1994). This essay concentrates on the use of snowmobiles for reasons of conciseness, but Wenzel additionally discusses the use of technologies such as rifles and outboard motors. As discussed in the next section, trade with Euro-American whalers had introduced earlier forms of technology, such as metal tools, to the North long before the roar of snowmobiles echoed across Arctic snowfields. These metal tools in turn had augmented existing toolkits that included hide scrapers, harpoons, and knives fashioned from bone, sinew, antler, and stone (Lemoine 1997, Maxwell 1985). The larger point is that snowmobile technology was not introduced into some sort of “pristine,” technology-free social environment. Instead, it was adopted as another innovation into a way of life that had always been dependent on technology – a dependence essential to human life in an environment of (for most of the year) extreme cold and limited opportunity for easily gathering food.

The focus is also geographically restricted to the Canadian Arctic, although intriguing research has examined similar issues in other high-latitude regions. Pertti Pelto, for example, has

extensively studied the introduction of snowmobiles among Finnish Laplanders, comparing and contrasting their experiences to those of Canadian Inuit (Pelto 1973, Pelto and Muller-Wille 1972), and Edwin Hall (1971) has published similar research related to northern Alaska. This case study draws on some of their ideas but remains generally focused on northern Canada. A focus on the Canadian Arctic is still quite broad, of course. The utility of snowmobiles may vary considerably depending on local factors of topography, climate, and reason for use (Pelto and Muller-Wille 1972: 169), and therefore any general conclusions in this paper may not apply equally to all localities. For example, Bernard and Pelto's *Technology and Social Change* (1972) contains a number of paraphrased interviews with ethnographers about the communities in which they study, and often these anthropologists display marked differences in their evaluations of snow machine usefulness. In one case, David Stevenson's study of Broughton Island generally portrays the switch to mechanized travel as positive (*ibid.*: 180), while Lee Guemple argues that snow machines have not been advantageous to the people of Belcher Island (*ibid.*:184). Of course, individual researchers may often be predisposed to view technology as either beneficial or harmful; nevertheless, such variation in responses underscores another larger point: due to physical, social, or economic constraints, the utility of any particular technology can vary greatly between regions, communities within a region, or even households in a single population center. What is useful in one situation may be inefficient or create dependence in another. This point is a major tenet of the "appropriate technology" perspective, further described in a later section of the essay.

THE SNOWMOBILE REVOLUTION (1965-1970) IN CONTEXT

For millennia, the Far North has been one of the most sparsely populated regions of North America. For example, in the

Nunavut Territory³ of the eastern Canadian Arctic, government figures indicate that population density does not exceed 1 person per 100 km², and in this self-autonomous region of 1,994,000 km² (approximately six times the size of Germany) there exist 21 km of highway (Nunavut Planning Commission 2003a).

Archaeological research indicates that the eastern Canadian Arctic has been inhabited for at least 4,000-4,500 years (Maxwell 1985: 37), for which time as many as four distinct cultural periods (possibly associated with in-migration of populations from the west) are identifiable in the archaeological record (*ibid*: 43). By the early nineteenth century the British had sent several explorations into the Arctic, but the first Euro-Americans to significantly impact the economic lives of Arctic peoples⁴ were American and Scottish whalers, who by the 1860s began pressing Inuit men into service for their specialized maritime knowledge (Creery 1994: 110, Dickerson 1992: 16). By that time, the Hudson's Bay Company was expanding into the archipelagoes of the Canadian Arctic, and by the turn of the century many men of the region had "forsaken their traditional hunting ways (in which trapping was relatively unimportant) in order to trap the furs which they could trade for goods – guns, bullets, knives, flour, tea, and tobacco" (Creery 1994: 111). In the 1940s the fur trade collapsed because of plummeting prices, and without income to acquire the trade goods upon which they

³ Nunavut Territory, created on April 1, 1999 after decades of political struggle and negotiation with the Canadian national government, represents a fascinating story in itself. Populated overwhelmingly by Inuit, the Territory exercises a form of self-government more independent from the federal government than other Canadian provinces and territories (Nunavut 2003a, Nunavut 2003b, Creery 1994, Dickerson 1992).

⁴ This essay employs general terms such as "Arctic peoples" in place of the term "Eskimo"-- considered slightly derogatory because of its history by some, though not all, people in Arctic communities (much like "Indian" in the U.S. Southwest). "Inuit" refers specifically to native peoples of the eastern Canadian Arctic.

depended, some Arctic families attempted to return to traditional hunting for subsistence, only to find in many cases that changing wildlife migration patterns had left their lands barren of game (Duffy 1988: xvii). In response to public accounts of Inuit starvation, and perhaps more fundamentally as part of an overall strategy to assimilate indigenous peoples into mainstream Canadian society, the federal government forced Inuit to resettle in permanent government towns and villages, even shooting dogs to prevent a return to seasonal camps (Creery 1994: 113). The Canadian government made efforts to provide health care and educational services in these camps (Wenzel 1986:71). In the ensuing two decades people attempted to adjust to their enforced dependence on the federal government. By the late 1960s, as the first generation of children educated in government schools came of leadership age, Canadian Arctic natives who questioned the dominance of the federal government began to organize politically (Mitchell 1996: 423). In 1971, Arctic peoples formed the Inuit Tapirisat ("Brotherhood") of Canada to resist increasing pressure to develop possible oil fields in the Nunavut region (Duffy 1988: 235), and the organization began a long campaign to regain control of Northern lands claimed by "aboriginal title" (Creery 1994: 113).

Snowmobiles first arrived in most Arctic communities in the early 1960s, but did not become widespread until the later years of that decade. Once the technology took hold, however, communities often converted almost completely to snowmobile use in very short periods of time. For example, Peter Usher reports that there were a few snow machines in Banks Island by 1963, but that these were subject to breakdown and no more were purchased until 1966. Unlike the first Ski-doo's, however, these 1966 machines were introduced during a "fantastically good" trapping season for the entire community. When the machines proved successful, almost everyone ordered one for the 1967 season with their money from the bountiful previous

year (in Pelto and Muller-Wille 1972: 182). Although specific details vary, the experience of Banks Island residents exhibits a pattern of fast, widespread adoption of the snowmobile typical to many Arctic communities (Smith 1972: 2, Wenzel 1986: 71, Hall 1971: 242, and Richard Hill in Pelto and Muller-Wille 1972: 181).

The Banks Island example suggests several reasons for the widespread, half-decade delay in snowmobile adoption. The first is a “wait-and-see” attitude towards the new technology. It is telling that, since one of the 1966 machines was a Polaris Colt, “several Polaris machines were ordered in response to this successful ‘demonstration’” (Usher in Pelto and Muller-Wille 1972:183). Other reasons for delayed adoption include the high cost of a snowmobile and its often frustrating and sometimes dangerous disadvantages, discussed below. High initial cost also partially explains why, for the most part, the first native people to experiment with the new technology were not full time hunters, but wage earners with greater and more reliable cash incomes (Moyer in Pelto and Muller-Wille 1972:186).

C.S. Holling (2001) has proposed an intriguing model of systemic change that might usefully frame consideration of the adoption of the snowmobile in the Arctic. In what he terms “panarchy” (combining conceptions of rigid hierarchy and fluid adaptive systems), cycles operate at various levels and speeds of change in an ecosystem structure. Because change in fast, highly variable and flexible cycles does not always coincide with moments “vulnerable” to change in slower, longer-term cycles, the effects of changes from smaller cycles on the overall system are dampened, and the stability of the overall structure tends to be maintained. However, a mechanism for systemic evolution (such as the widespread adoption of a form of technology by members of a society) does exist, and is dependent on the fortuitous (in terms of spurring change) coincidence of

conditions across multiple cycles⁵. In terms of Holling's model, individual human agency, in this case the choice between various forms of available technology (such as a dog-pulled sledge and a snowmobile) might be considered a flexible, fast-adapting cycle. But the implementation of that choice (e.g., actually purchasing a snowmobile) is constrained by larger cycles. To return to the Banks Island example, in order for widespread switchover to snowmobiles to occur, the desire to purchase the machines coincided in 1966 with at least two larger-scale cycles beyond the control of the village's inhabitants that produced a "fantastically good" trapping season: bountiful populations of the wildlife to be caught and commodity prices for the catch high enough to provide capital to purchase the snowmobiles. It is crucial to note that a systemic perspective on societal change such as outlined here does not necessarily exclude considerations of the operation of power in human relations. Following Wolf's (1999) terminology, power can be envisioned at all three levels of change in this example: influencing human choice and desires through advertising and pressure to adopt the "superior" cultural/technical modes of a dominant colonial state, affecting wildlife populations through the political negotiation of government resource management policies, and as functioning in the ways that exchange rates, international terms of trade, and global fluctuations of supply and demand set prices for locally-caught, "commoditized" wildlife harvests (Greenberg, in press: 9).

Another constraint to snowmobile purchase set by those

⁵ An article by Stuart Kauffman (1991) indirectly suggests an interesting extension of this idea. The vast majority of genetic mutations never become expressed as structural evolutionary change in subsequent generations, because they do not coincide with conditions of the organism or the ecosystem within which an organism reacts that will favor the replication of that particular random mutation.

with the power to manufacture and distribute the technology, purchase cost, is considered in the next section, along with other practical disadvantages of snowmobile ownership.

PRACTICAL DISADVANTAGES OF SNOWMOBILES

The switch from dog teams to mechanized transport presented new challenges to Northern hunters. These unfamiliar problems included high costs (both for initial purchase and for operation), the possibility of mechanical breakdown, and limitations on the type of terrain suitable for snowmobile use.

Perhaps the most challenging new issue facing snowmobile owners was the very cost of owning one. Snow machine prices during the period of their adoption ranged from slightly over \$600 at Clyde River in 1960 (Wenzel 1994: 299) to about \$1400 in the same community 12 years later (Wenzel 1989:9). Another observer reports a price of more than \$1000 for the least expensive model in Hopeland, Labrador by 1975 (Richling 1989: 68). Other data includes a figure of \$850+ in Pond Inlet in the early 1970s (Smith 1972: 2) and prices between \$795 and \$1,095 in Kotzebue, Alaska in the late 1960s (Hall 1971: 243). Even a comparison of the lowest numbers in the literature to the average Arctic wage-earner's annual net income of \$1,195 in the 1960s (*ibid.*) clearly demonstrates that snowmobiles represented major financial investments during the time of their spread. For full-time hunters, lacking ready access to steady supplies of cash, investment in the new technology might have carried even greater risk.

The cost of a snowmobile was hardly limited to its purchase price. Because of the harsh conditions of Arctic use, mechanical parts required frequent replacement. Traction belts, which very commonly corroded from contact with saline sea ice, could easily cost a hunter \$80-\$100. Spark plugs, fan belts, suspension springs, and oil seals also wore out all-too-quickly (Pelto and Muller-Wille 1972: 188). Gasoline represented another significant cash outlay. Unlike dog teams, engines could not be

resupplied with fuel "on the trail," and extra gasoline was a necessity on all trips (Smith 1972: 4). Gas supplies were often sporadic and uncertain in Arctic areas during the late 1960s (Guemple in Pelto and Muller-Wille 1972: 184), and even when available, fuel was quite expensive. Lorne Smith calculated that, using 65 gallons per month at \$1.10 per gallon (in 1972 dollars), gasoline was costing the average Inuit hunter in Pond Inlet \$71.60 per month in 1972. Adding in the purchase of oil and the average costs for maintenance raised the monthly figure to \$134.40 – twice the cost of operating a car in southern Canada (Smith 1972: 6). Even accounting for variation in these numbers, it seems evident that the snowmobile represented a significant drain on the owner's financial resources.

Worn parts caused frustration and were expensive to replace, but they could also jeopardize a traveler's life in the event of a breakdown. Snowmobiles in Arctic communities were consistently used for hauling heavy loads over rough terrain in extremely cold temperatures, conditions which created numerous opportunities for mechanical failure (Pelto 1973: 77). Unlike a dog team, in which the other dogs could keep pulling if one was injured, a badly-broken snowmobile was simply immobile until repaired. Because of the increased speed of a snowmobile, hunters tended to venture farther away from their communities, making breakdowns even more dangerous (Smith 1972: 4). Furthermore, in the event of an emergency, hunters were unable to eat their new machines as had been possible with dogs, for "there is little nourishment in boiled Ski-doo track" (*ibid.*). Mechanical failure resulted in losses of productivity and potentially-dangerous situations, leading to the oft-repeated statement, "Dogs are slow, but they don't break" (*ibid.*).

Another disadvantage of the snow machine was its limited range of use. Lee Guemple reports that snowmobiles could only be used on the sea ice of Belcher Island because the land ice was too rough (in Pelto and Muller-Wille 1972: 184), while David

Stevenson's description of Broughton Island indicates that snow machines could neither bridge crevasses as effectively as longer dog sleds nor jump and swim from block to block in broken ice as could dog teams (*ibid.* 181). It has also been suggested that, by stopping before dangers such as hazardous ice and crevasses, dogs offered a unique "early warning system" to the Arctic hunter (Smith 1972: 4, Guemple in Pelto and Muller-Wille 1972: 184).

The snowmobile was clearly not without shortcomings. High costs of purchase and maintenance, mechanical breakdowns, and a narrow range of negotiable terrain all limited the snow machine's utility, yet snowmobile use spread rapidly across the North. To many hunters, the potential benefits must have been remarkably attractive in order to outweigh the problems that they had already observed during the delay between the presence of the first snowmobiles and their widespread adoption.

PRACTICAL ADVANTAGES OF SNOWMOBILES

The snowmobile was by no means a perfect adaptive tool; nevertheless, as Pelto and Muller-Wille suggest, "The snowmobile revolution [was] a revolution because of a quantum leap in mobility. Human history suggests that people have always devised ways to pay for quantum leaps of that magnitude, no matter how expensive they are" (1972: 190). The explosive increase in snow machine use in the Arctic during the late 1960s lends credence to such a statement. The advantages that Northern people devised ways to pay for center around one concept: speed.

In good travel conditions, dog teams can travel about 40 miles in one day, a distance that can be covered in three hours with a snowmobile (Pelto and Muller-Wille 1972: 190). Without question, this kind of speed offered a significant advantage to Arctic hunters who traveled long distances seeking the tundra's unevenly distributed game. Not only could hunters range over

larger areas in their searches, but they could often also shorten the duration of their trips. Richard Hill states that, using snow machines, residents of Inuvik on the MacKenzie Delta commonly engaged in one-day hunts involving distances of about 100 miles (in Pelto and Muller-Wille 1972: 181). Such a venture would translate into at least a two- or three- day trip with a dog team. Lorne Smith also notes the advantage of speed, stating that, "Over the weekend, Pond Inlet men can go 40 to 60 miles to caribou country, kill one or two caribou, and be back in time for the evening church service on Sunday night" (*ibid.*: 2). David Smith has commented that on Broughton Island, a trip to the edge of the sea ice to hunt seals used to take four or five days, but with snowmobiles travel time was reduced to twelve hours. He notes that with the new technology, Inuit men routinely accomplished the journey in a single day (in Pelto and Muller-Wille 1972: 190).

Snowmobiles were fast in another way. Whereas harnessing a dog team and preparing it for travel will usually take at least thirty minutes (Pelto and Muller-Wille 1972: 189), starting a well-tuned snowmobile is an almost instant procedure. Combined with the snowmobile's greater maneuverability (because of its compact size and directly-controlled responsiveness), this reduced starting time made the snowmobile a much more convenient tool for short trips than dog teams ever were. One anthropologist has noted that Inuit, in a manner reminiscent of their automobile-crazed neighbors to the south, would "often spend ten minutes starting a frozen Ski-doo rather than take five minutes to walk to the store" (Smith 1972: 3).

The unique capabilities of a snowmobile contributed to increased hunting efficiency and effectiveness. Lorne Smith's surveys of the Pond Inlet population revealed that 50% of Ski-doo owners had increased their hunting yield since acquiring the new technology, while the rest reported that productivity had remained about the same (1972: 6). Even given a constant

rate of productivity, however, decreased time spent in traveling during subsistence activities equated to increased efficiency. At Clyde River in Canada the caribou catch skyrocketed from an average of 160 per year to 992 per year following the adoption of mechanized transport, and the catch of ringed seal increased from just over 200 per year to 4,700 per year (Wenzel 1989: 8,12). Although factors such as fluctuating natural populations (especially common for caribou) might partially explain these changes, the snow machine almost certainly played a role in the increased productivity. A snowmobile is actually faster than a caribou or polar bear, and that speed (combined with its maneuverability) enables a hunter to chase down game instead of waiting for it to come to him (Hall 1971: 2). The increase in seal catch might be due to reduced travel time to breathing hole areas encouraging more frequent trips.

The snowmobile improved the productivity not only of subsistence hunting, but also of fur trapping. On Banks Island, snowmobiles significantly decreased the amount of time required to run a trap line, making a trapper's time more efficient and also reducing the losses out of traps due to scavenging by wolves and foxes (Usher in Pelto and Muller-Wille 1972: 183).

A final set of advantages to snowmobile use focuses not on what it allowed people to do, but on what it freed them from doing. Lee Guemple has calculated a cost of about \$3 per day for operation of a snowmobile and an equal figure for the cost of maintaining a dog team (accounting for the cost of dog food in time and money, the value of time saved because of the speed of the snowmobile, repair and fuel costs, etc) (Guemple in Pelto and Muller-Wille 1972: 185). Whether his numbers are exact or not, the factors he includes underscore the point that before the spread of Ski-doo's, obtaining dog food was a relatively major subsistence objective in terms of time spent (Hall 1971: 3, Richling 1989: 65, Pelto and Muller-Wille 1972: 189), and capital invested in the form of guns, ammunition, and boats (Usher in

Pelto and Muller-Wille 1972: 183). Particularly for wage-earners who were now able to supplement their households' livelihoods by hunting on weekends, increased hunting efficiency and range also provided many Northern families the opportunity to avoid (or reduce reliance on) store-bought food that can be astoundingly expensive in the Arctic⁶. As summed up by Smith from his study at Pond Inlet, "The cost of eating store food would mean as much or more money being spent on food as in now being spent on Ski-doo operation" (*ibid.*: 8).

THE SNOWMOBILE'S IMPACTS ON ARCTIC LIFE

Not surprisingly, increased reliance on mechanized transport resulted in a decline in dog use. In one MacKenzie Delta community, the dog population decreased from 1,000 in 1958 to 200 in 1968 (Hill in Pelto and Muller-Wille 1972: 181), and in Noatak in northern Alaska there were 500 dogs in 1960 and only 259 remaining by 1968 (Hall 1971: 246). These statistics are particularly striking when one considers that dogs commonly have lifespans of ten years or more. The changeover at Broughton Island offers an especially telling example. When a 1963 rabies epidemic killed off about 95% of the dog population, every village household purchased a snowmobile and did not replace its dogs (David Stevenson in Pelto and Muller-Wille 1972: 180). Thus, when faced with the challenge of acquiring harvesting equipment essentially "from scratch," former dog owners unanimously decided that the advantages of snowmobile use outweighed its costs and limitations, which they had already been able to observe because snowmobiles had been previously introduced into their community (*ibid.*). It does

⁶ As a modern day example, in 1999 two liters of milk in the largest town in Nunavut Territory cost about \$5.75 Canadian (Nunavut Planning Commission 2003a). If one does the conversions at the current exchange rate (May 3, 2003), it works out to \$4.10 (American dollars) for a half gallon. In comparison, at the convenience store across the street from the author's hovel, a half gallon of milk costs \$1.85.

not seem a stretch to state that in the late 1960s “the sound of dogs howling [was] being rapidly replaced by the roar of Ski-dooos” (Smith 1972: 9).

The adoption of snow machines also significantly impacted the economic structure of many Arctic communities during the late 1960s. Although a shift toward wage-earning jobs in government or southern corporations may have begun before its arrival, the snowmobile may have accelerated the trend because the new technology required significant cash investments (Hall 1971: 243)⁷. A second economic change, summed up by one scholar, is a possible increasing gap in prosperity between part-time wage-earning hunters and full-time subsistence hunters:

A certain minimum income is essential to hunting and fishing....Because of increasing mechanization the minimum cash income is continually rising. Unless wage opportunities increase accordingly, there is reason to believe that the gap will grow between the properly equipped and the ineffective hunter (Francis 1969: 78).

In Aklavik on the MacKenzie Delta, only a wage-earning elite, ten percent of the population, was able to purchase a machine in the initial years of introduction (Derek Smith in Pelto and Muller-Wille 1972: 181-182). Similarly, Lorne Smith notes that 79% of Pond Inlet wage earners owned a Ski-doo, compared to only 23% of full-time hunters surveyed (*ibid.*: 6). This pattern may not hold over the entire Arctic, however, as evidenced by situations in Inuvik, Broughton Island, and Grise Fiord, where almost all community members owned snowmobiles within a few years of their introduction (Hill in Pelto and Muller-Wille

⁷ This shift to wage-earning, however, would have been limited by the low number of jobs available, a situation that has continued into recent times, with 60% of Inuit adults in Nunavut participating in any form of wage economy in 1994 (Nunavut Planning Commission 2003a). The author’s research uncovered little information on the topic, but it would be interesting to further pursue the question of whether migration to southern Canada to find wage labor increased in any significant way during the years of the “snowmobile revolution”.

1972: 181, Stevenson in Pelto and Muller-Wille 1972: 180, Milton Freeman in Pelto and Muller-Wille 1972: 185-186).

Discussion of the potentially adverse environmental effects of snow machine use in the Arctic has focused on issues of overhunting and pollution. Direct physical impact (i.e., vehicle tracks) on the tundra itself is negligible because Ski-doo's are only designed for travel on snow.

One scholar has raised the possibility that increased efficiency in trapping may lead to overharvesting of local game populations (Usher in Pelto and Muller-Wille 1972: 183). Such overhunting was partially offset, however, by a decrease in the amount of game killed for dog food (Pelto and Muller-Wille 1972: 197), though different species might have been involved. It is also possible that the increased range of hunters using snowmobiles may have eased pressure on some wildlife populations. When Inuit families were relocated to centralized settlements in the 1940s, new problems were created. The tundra is a region of relatively low biological productivity, and the ecosystems surrounding these new settlements began to prove unable to support the higher concentrations of hunters. With the adoption of snowmobiles, however, hunters were able to disperse more widely in their searches for game (Wenzel 1994: 298-299). Overall, evidence for overhunting as a result of snowmobile adoption is mixed (Pelto and Muller-Wille 1972: 197-198), complicated by the rapid fluctuation of tundra faunal populations (Nelson 1983: 209-212).

Pelto and Muller-Wille postulate that air and refuse pollution, caused respectively by internal combustion engines and the junking of old machines, may have increased proportionally with expanding snowmobile use (*ibid.*: 197). But population density in the Arctic is so low overall that these issues are not likely to develop into major problems unless migration from the south exponentially increases the population

of northern areas, something that to date has not occurred (Nunavut Planning Commission 2003a).

The snowmobile also influenced Inuit social patterns involving inter-community interaction and social stratification. Snow machines' speed enabled increasing interaction between members of widely-spaced communities, potentially encouraging (along with other technologies such as radio, television, and eventually the Internet) the type of political mobilization necessary in struggles towards the establishment of Nunavut (see for example Matthiason 1992: 151 and Nunavut Planning Commission 2003b)⁸. Pelto and Muller-Wille note that Inuit on snowmobiles commonly made the 350-mile journey between Clyde River and Broughton Island, while snowmobile and dog races (which became more common as sled dogs became less-essential to subsistence needs) "contributed still more opportunities for the intensification of the social network" (*ibid.*: 194).

As mentioned earlier, snowmobiles may have amplified the distinction between wage earners and full-time hunters in some communities. David Moyer notes that Southampton Island wage-earners tended to own snowmobiles because of a larger cash supply, limited time for dog team care and travel, and generally "pro-white attitudes" toward technological and other innovations (Moyer in Pelto and Muller-Wille 1972: 186). But surprisingly, the snowmobile may also have tied wage earners closer to "traditional" aspects of native Arctic life. Moyer's same Southampton Island research also reveals that, since the increased efficiency of hunting with a snowmobile allowed wage earners to pursue traditional subsistence activities during

⁸ As mentioned earlier, however, it is important to note that many Inuit were being resettled into permanent government villages during this time (Creery 1994: 113). Technology itself is never a *cause* of social change. While it may sometimes catalyze new forms of interaction, or intensify social processes already in operation, technological adoption always plays out in a larger context of finance and political power.

evenings, weekends, and other off-hours, they were able to resume participation in the reciprocal meat-sharing exchanges so crucial to the community's social integration. Not only did their snowmobile purchases not necessarily lead to increasing isolation of wage earners from more "traditional" subsistence hunters; in fact, they may have "help[ed] to conserve traditional social patterns by putting the wage earners back into traditional hunting action" (*ibid.*: 194).

One scholar has defined Inuit subsistence, a crucial marker of native identity, as "the production of food for domestic consumption" (Wenzel 1994: 13). By this definition, a wage-earner's part-time hunting, made workable by the efficiency of the snowmobile (Hall 1971: 244, Smith 1972: 6), thus represents continuance of a traditional subsistence livelihood that might not otherwise have been possible. Other continuities further debunk the idea that the very presence of snowmobiles automatically represented "cultural diminishment" in the Arctic. Reciprocal relationships important in pre-snowmobile times do not appear to have been diminished, as evidenced by the meat-sharing example cited above and the observation that snowmobiles themselves were commonly shared (Richling 1989: 65, Hall 1971: 243). Finally, changes in hunting technology do not imply that animals are no longer hunted in culturally-appropriate manners, including respectful treatment, observation of taboos, and offerings of thanks. In the words of Richard Nelson, "ideological constraints are applied to the new technology, as to the old" (1983: 242).

THE "COMMON EVOLUTION" OF TECHNOLOGY AND CULTURE

This case study of the adoption of the snowmobile in the Canadian Arctic suggests that generalizations about whether the introduction of novel technology is beneficial or detrimental in the Third (or Fourth) World are simplistic and not very informative. To begin with, the very terms "Third World" and "Fourth World" misleadingly suggest a nonexistent

homogeneity of problems and potential solutions. While true that populations and nations thus labeled tend to occupy similarly marginalized positions in hierarchies of power at various scales, the worries and perspectives of an Inuit seal hunter are by no means equivalent to the concerns of a sorghum farmer in northern Cameroon or a blanket weaver in Guatemala. Nor do all hunters, farmers, and weavers within those communities face the same challenges or have access to the same opportunities.

The utility of a specific technology to any one person will vary greatly by region, by settlement, by household, and even within a household, as divisions of age and gender may constrain who has access to and can benefit from the use of a new innovation. But the fact that a technology is useful (the widespread adoption of the snowmobile despite its costs makes clear that it was considered so by many households in the Arctic) does not necessarily mean that it is beneficial. The changes in peoples' livelihoods and ways of thinking that are associated with the adoption of new technologies may in some cases result in the loss of values and traditions important to those people. The Internet, for example, is remarkably useful but its potential for increasing isolation of individuals fixated on a virtual world is a cause of concern to many. But again, technological change does not always result in cultural "losses" and in fact any zero-sum metaphor of overall gain or loss may be entirely inappropriate. *Simply phrased, when technology changes, culture changes because technology is an inextricable component of culture.* A common metaphor employed by scholars in technology studies is that of the "seamless web" in which distinctions are not drawn between "technical, social, economic, and political aspects of technological development" (Bijker, Hughes, and Pinch 1987: 3). As an influential member of the Social Construction of Technology school has written, "Rather than being satisfied with the distinction between technology and its context as the basic dimension for analysis, we must figure

out a way to take the common evolution of technology and society as our unit of analysis" (Bijker 1995: 10).

Technologies are neither inherently harmful nor inherently beneficial, and their impacts can only be meaningfully considered as part of this process of "common evolution" with economic, political, and ideational facets of culture. Individual human beings exercise agency in choosing and wielding technology, although the array of technologies accessible to them (and their options for using them) are constrained by their political and economic relations with other people. From a political ecology perspective, the choice and manner of using technology might be said to mediate human interaction with nature, which in turn influences relations between human beings in the operation of modes of economic production (Greenberg, in press). These material economic relations are themselves intimately tied to processes of reinforcement or re-imagination of ideational aspects of culture, which in turn can function to strengthen or to contest the political and economic relations between people (Smith 1999, Wolf 1999). Coming full circle, both ideas of what is appropriate (or even thinkable) and political (or economic) constraints then limit what technologies are considered desirable and what technologies are accessible. In rural Guatemala girls do not ride their brother's bicycles, in Nunavut hunters without wage work took longer to acquire snowmobiles, and in Europe debates about the importation of genetically-modified wheat and strawberries rage on.

OTHER SOCIAL SCIENCE PERSPECTIVES ON TECHNOLOGY

The previous section reviewed some of the insights of the Social Construction of Technology school, particularly the concept of a "seamless web" of technology and culture. In drawing to a close, this essay now briefly reviews various perspectives on technology within scholarly movements more familiar to anthropological students, and situates the historical data uncovered during research for this case study within these

broader theoretical schools.

In anthropological circles, theories of economic modernization have come to be personified by W. W. Rostow and his writings about economic "take-off" and growth in developing nations. He describes technology as one possible catalyst of economic development, a "sharp stimulus" to the take-off that "may come about through a technological (including transport) innovation, which sets in motion a chain of secondary expansion in modern sectors and has powerful external economy effects which the society exploits" (1956: 31). For Rostow, such expansion is inhibited by the "problem of overcoming traditional values inappropriate to economic growth" (*ibid*: 30). It seems apparent that in the Canadian Arctic, where extremely low population densities and limited wage labor would seem to preclude the sort of industrial take-off of which Rostow writes, "traditional values" were not "overcome" by the snowmobile.

Unlike Rostow, dependency theorists do not view "underdevelopment" as an evolutionary stage from which developed nations have since "taken off"; rather, the problems of poverty in the Third World are seen as very much produced by present asymmetrical structural economic relations in which overall capital flows favor enrichment of already powerful nations (Frank 1969: 3-4). Dependence is seen to be "caused by the use of science and technology in the hands of those who monopolize it and thereby increase their power and domination" (Frank 1984: 15). One scholar has described in detail how the introduction of "modern" fishing technology in South Indian villages exacerbated preexisting local differences in wealth, and resulted in an overall decline in household protein intake as locally-caught fish were now being sold as luxury goods (out of the price range of the villages' new wage laborers) in far off metropolitan centers (Galtung 1974). Again demonstrating the need to evaluate specific technologies in specific geographical, social, and historical contexts, it seems

that the introduction of snowmobiles did not generally follow a similar pattern. These theorists' description of relations of dependence on technological transfer from centers of power (and the ways in which that transfer is structured to create dependence) represents a powerful critique of world economic systems, but in this case study, it does not appear to have resulted in impoverishment on the local scale. In fact, in some cases, the use of snowmobiles appears to have increased household independence and flexibility by allowing hunters to pursue subsistence activities as a livelihood strategy rather than rely on scarce wage labor opportunities.

Postmodern critiques of development assert that the discourses and practices of development alter not only economic relations in targeted countries, but also "cultural meanings and practices" (Escobar 1988: 438) through the expansion of Western ideologies and values such as capitalism and the desirability of progress. One scholar's summation of development/modernization views of technology states, "Technology was theorized as a sort of moral force that would operate by creating an ethics of innovation, yield, and result. Technology thus contributed to the planetary extension of modernist ideals" (Escobar 1995: 36). In the case of the snowmobile in Arctic Canada, the technology was certainly viewed as modern, and purchased and maintained through a capitalist monetary system. However, when one considers how this technological tool was wielded once accessed, it is clear that in some cases snowmobile use decreased reliance on a capitalist system of wage labor and commodity purchase, by again making possible subsistence hunting for a family's own food (i.e., reasserting control over the mode of production). Additionally, snowmobile technology generally appears not to have significantly impacted values and ideologies, as evidenced by, for example, the forms and cosmological meaning of hunting rituals. In some cases, it may even have functioned to reestablish traditional reciprocal relationships (such as meat-sharing on

Southampton Island) that had been in danger of eroding. As one postmodernism-influenced scholar has usefully noted, it is a mistake to automatically presuppose “intact traditions” and to assume that technology thus represents a contamination of traditional cultures (Tsing 1993: 105), particularly in a place like the Canadian Arctic where new technologies have been adopted from outsiders or in-migrants and modified for at least 4,000 years (Maxwell 1985: 43). Nevertheless, the historical evidence that in some localities adoption of the snow machine amplified economic distinctions between community members is an important reminder that no technology must ever be assumed to benefit all people equally in all places.

Yet another theoretical perspective, concerned less with the impact of “technology” generally and more with the types of tools and skills promoted, centers around the concept of “appropriate technology”. The verses sacred to the field’s practitioners were written by the economist E. F. Schumacher in *Small is Beautiful* (1973). Following the words of Mohandas Gandhi, who taught that what the poor of the world needed was not mass production but production by the masses (Pearce 2001: 170), Schumacher wrote that:

If that which has been shaped by technology, and continues to be so shaped, looks sick it might be wise to have a look at technology itself. If technology is felt to be becoming more and more inhuman, we might do well to consider whether it is possible to have something better – a technology with a human face (1973: 122).

An appropriate technology has several defining characteristics: it costs very little, is easy to build and repair, requires only materials readily available in the community, addresses a household’s expressed need⁹ of improving health conditions

⁹ Of course, a “household” is never an internally-homogeneous unit. As an appropriate technology extensionist in rural Guatemala, the author often found that men in a household wanted to build portable wash basins that were as high and large as possible. But women generally preferred basins

and/or generating income, minimizes consumption or contamination of natural resources, and is constructed by the family that will use it (or a local expert such as a carpenter or mason) (Diwan and Livingston 1979: 91-93, Evans and Adler 1979: 43-45). The term "appropriate" refers to the recognition that a specific technology that functions effectively in one particular context (climatic, economic, social) may be a significantly less optimal solution in another¹⁰. In the Canadian Arctic, the snowmobile appears to have represented an "appropriate" technical solution in some cases and not in others, as it was adopted at varying rates and with varying results in different communities. Certainly its adoption appears to have been beneficial to individual households in many cases. But if the requisite characteristics of an appropriate technology are reviewed, the snow machine seems to have fit none of those criteria in the Arctic of the 1960s. It was relatively expensive, built in a faraway factory, contributed to air and noise pollution, and required a fair degree of expertise to maintain and repair. Yet, even if the snowmobile was not "appropriate" as that term is defined in development discourse, it was adopted widely with reasonably successful results in many parts of the Arctic.

It seems that there exists a generally unrecognized category

that were lower to the ground (more comfortable to bend at the waist and scrub clothing) and lighter (more easily moved from the well in the dry season to the roofwater-catchment tank in the rainy season).

¹⁰ Another example from the author's own experience illustrates this idea. In one highland Guatemalan community, the author collaborated with village masons to develop a style of wood-burning cookstove that reduced firewood consumption by 40-45% and removed smoke from the kitchen environment at a total cost of 48-52 *quetzales* (approximately \$6 U.S. in 2001). In a second village in a more arid region of the country, households were unable to spare that amount of money and the 28 bricks in the original design required a three-hour walk or horse ride to the town at the base of the mountain. Having seen the author's photographs of the design, a woman in the second community, with her teenage son, built a version of the stove using discarded *tejas* (fired ceramic roof tiles) in place of bricks and reduced the cost of the stove by half.

of technological change, somewhere in between high-tech, high-capital industrial transformation and low-tech, low-capital appropriate technology. Adoption of the snowmobile in the 1960s may represent such a case. Johan Galtung, at the end of his article on fisheries in South Indian villages (discussed earlier in this essay's consideration of dependency theory), proposes that the negative effects of the introduction of "modern" fishing technology (including large fishing ships and freezing facilities) might have been avoided by a strategy promoting "intermediate" technology, such as outboard motors (1974: 50). Such "intermediate technologies" may sometimes function as technological shortcuts. For example, rural Central America's cellular phones (often purchased with remittances from migrant relatives in the United States) significantly enhance villagers' ability to maintain communication with those relatives without massive public investment in the infrastructure of land-based telephone lines.

CONCLUSIONS

Through analysis of accounts drawn from ethnographic and historical sources, this essay has sought a more complex and satisfying answer to the simplistic question of whether adoption of the snowmobile in the North American Arctic resulted in "cultural loss". It is clear that widespread adoption of the snowmobile technological complex (machines, fuel, tools, skills, knowledge) caused significant changes in life in the Far North. Characterization of such changes as cultural loss or diminishment, however, is not a useful path to pursue and overextends the argument. For example, the meanings and values associated with traditional subsistence hunting were generally not lost, and in some cases were reinforced during this period of technological transition. Moreover, on a more fundamental level, it must be remembered that adaptation and change have always been crucial to survival in places of extreme ecological variation, and that technology cannot be considered

to be separate from culture in any society. In fact, the snowmobile was just one more stage in the common evolution of technology and culture that has for millennia made human life possible in the unforgiving environment of the Far North.

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