

Northern People, Northern Resources, and the Dynamics of Carrying Capacity¹

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ABSTRACT. In contrast to other organisms, people relate to environments through a changeable technology, have highly variable resource demands, and can conduct long-distance trade to supplement local resources. Nevertheless, total human demand may exceed, equal, or fall short of "carrying capacity" under particular cultural, economic, political, and environmental constraints. Many northern communities seem to have outgrown local renewable resource limits. They can sustain themselves only by reducing demand, drawing down banked reserves, channeling local natural productivity into items of greater direct utility, accepting subsidies and dole, or agreeing (or selling rights) to development of exhaustible resources mainly with nonlocal capital. Each choice carries costs and benefits. For many communities the loss of identity and self-determination may be the most pernicious problem with the choice to host major nonrenewable resource projects.

Key words: carrying capacity, environmental limits, community self-determination

RÉSUMÉ. Contrairement aux autres organismes, l'espèce humaine entretient un rapport avec ses milieux à l'aide d'une technologie en évolution constante, ressent des besoins très variables en matière de ressources et peut poursuivre un commerce de longue portée afin de pourvoir aux lacunes des ressources locales. Cependant, les exigences humaines totales peuvent excéder, égaler ou encore ne pas atteindre la capacité nécessaire en raison de certaines contraintes culturelles, économiques, politiques ou environnementales. Les besoins de bon nombre de communautés du nord semblent avoir dépassé les limites des ressources renouvelables locales. La réduction de la demande, l'utilisation de ressources en réserve, la concentration de la productivité naturelle locale vers des projets à utilité plus directe, l'acceptation de subventions et d'allocations, et les accords (ou la vente des droits) de développement de ressources temporaires surtout à l'aide de fonds non locaux, sont les seuls recours qui puissent assurer la survie de ces communautés. Chaque choix entraîne ses propres coûts et avantages. La perte de leur identité et de leur auto-détermination devient le problème le plus pernicieux que peut occasionner la décision de plusieurs communautés d'accepter un projet d'exploitation de ressources non renouvelables.

Mots clés: capacité de survie, limites environnementales, auto-détermination communautaire

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INTRODUCTION

Any discussion of the future of northern settlements, and certainly decisions about the pace and direction of community development, must include a realistic understanding of the interaction of population, individual wants and needs, and the currently useful set of natural materials and processes we call resources. To know where one stands in relation to those resources, to know what cultural and natural conditions define that relationship and might allow or force its change in the future, and to be able to distinguish actions that overshoot from actions that sustain a balance between humanity and nature is to increase community security and self-sufficiency in a world that daily has less of both.

Carrying Capacity and Communities: General Definitions and Comment

Animal ecologists speak of carrying capacity as a quantitative relationship between a local species stock and its habitat: the number of individuals that the available quantity of a limiting resource such as food can sustain. Over both a short and a long span of time, environmental change is the important variable affecting ecological carrying capacity. Whether carrying capacity ideas apply to humans is hotly debated. The crux of the argument is whether cultural evolution has essentially freed *Homo sapiens* from meaningful biophysical constraints. On the one hand there are numerous human societies

overtaxing the current resource base of a region and paying a price in poverty, social disintegration, starvation, and depopulation. It seems likely, too, that overarching ecological conditions still set broad limits to the settlement of the earth's cold and hot deserts and semideserts. On the other hand, local resource availability explains essentially nothing about the size and location of many of the world's cities. Furthermore, in front of the local market in Guildford, England, Malthus's ghost still paces in silent frustration. Certainly the concept must be dramatically altered to account for several fundamental consequences of cultural evolution:

1. Animals exploit environments with a genetically programmed set of equipment that changes almost unmeasurably from one century to the next; in contrast, the exploitive technology of humans changes rapidly. (This does not imply that lags in technology development and adoption are never important.)
2. Animals must obtain all needed resources within an area they as individuals can reach. Through trade, humans can be sustained by distant resources. Human settlement can occur in places supplying only a fraction of the total array of required resources. Nowhere in the world, perhaps, can one find a community relying completely on local resources.
3. Resource consumption rates (per capita) do not vary much among other animals, but consumption rates of food and other resources are highly variable among humans.
4. The resource demands of nonhuman animals are com-

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paratively fixed: particular kinds of food, environments for reproduction, shelter from predators and weather, etc. The whole concept of "resource" is highly dynamic in human societies, being largely defined by culture. Industrialized societies use many more landscape elements than hunter-gatherer or agrarian societies. Destruction and obsolescence eliminate items from the category of resources from time to time, while invention, discovery, price changes, and even scarcity (in the case of once-free goods like clean air) create others. Thus, human "resources" expand and contract, and with them, carrying capacity.

5. For animals environmental variation is the only factor significantly changing carrying capacity levels. For humans, with our storage mechanisms (including money) and capacity for resource substitution, environmental change is much more significant over the long run than in the short term. For example, global pollution may define carrying capacity in the future as, on a regional level, desertification and deforestation have done in the past and do in the present.

Do these sharp contrasts in animal and human resource relationships negate the validity of carrying capacity? I think not. Within the normal planning horizon of human endeavor — a few years to a few scores of years — we can perceive that human resource demands may undershoot, equal, or overshoot supplies. Demand or exploitive technology must then change, and a new relationship of communities to carrying capacity will result. Understood this way, carrying capacity has policy value as a test of the current fitness of human behavior in relation to the current limits of human habitat. If we can see that contemporary use patterns continued for a few years or decades into the future will exceed the capabilities of natural ecosystems and landscapes to supply them, we know that 1) behavioral changes are required, 2) new resources or enhanced ecosystem capacities must be developed, and 3) policy changes may be required to bring about either (or both). Today's concern over soil erosion in the United States' food-growing regions illustrates the point.

NORTHERN COMMUNITIES AND NORTHERN CAPACITIES

Not surprisingly, these general relationships take on a distinctive character in response to varying natural environments and cultural systems. Two communities in essentially the same natural setting may have greatly different relationships to resources — as, for example, a comparison of Anchorage with nearby Tyonek, Alaska, or of Whitehorse and Old Crow, Yukon, would show. The reason, of course, is that diverging lifeways result in different demands being placed on different resource sets. In the above cases, two communities oriented mainly toward local renewable resources are in stark contrast to two communities within the network of global trade and industry.

Settlements of the subarctic forests, the tundra, and arctic coastal regions have their own types of resource/population relationships. These relationships, the nature of the communities, and the expectations of residents all have varied historically and continue to change.

In pre-contact times many northern communities were small and nomadic, especially those depending on the sparse and shifting resources of inland reaches. Other communities, mainly coastal ones, were relatively large and fixed, although archaeological evidence suggests periodic abandonment and reoccupation even of sites that today boast abundant and fairly reliable food resources. Whether nomadic, shifting, or site-stable, however, these communities drew essentially all the resources they needed from a contiguous area accessible from the settlement or seasonal camps. Trade existed but rarely was crucial. The level of material consumption was miniscule by standards of industrial (or even of northern native) societies today. The level of self-sufficiency was extremely high.

Invading southern (white) cultures and resident northern societies interacted in complex ways affecting numbers, wants, mobility, and resources. Native populations sometimes declined dramatically (in Alaska, pre-contact population of 75 000 native people declined by 1890 to 25 000; Rogers, 1971). Surviving northern people often were forced by explicit policy or economic circumstance to form new settlements in locations decided by mission, school, or business officials. These settlements — now often thought of as long-established villages — are relatively new. Their inhabitants continue to draw on the countryside for some fraction of their needs but must satisfy some (usually most) of their resource requirements from earnings, welfare, and transfer payments.

The traditional resource base itself has been eroded during the past 200 years, the extent of that loss varying from region to region. Some whale populations have disappeared; caribou ranges have been cut by railroads, roads, pipelines, and impoundments; fish runs have been depleted; and institutional barriers have been erected against the use of other subsistence resources. At the same time, however, the needs and wants of southerners have created resources in the north. Caribou antlers (for aphrodisiacs or trophies), furs, ivory, jade, soapstone, art, scenery, oil, natural gas, coal, metallic minerals, sand and gravel, and timber are among many examples. Every northern community has been and continues to be faced by this simultaneous expansion and contraction of its resource base.

Finally, contact has greatly changed the needs and wants of northern people. Most consumer goods that an Ottawa householder would write on a list of needs or wants would also be on the list of a villager in the north. In addition, the villager would list special hardware items used in gathering country food: rifles, traps, snowmobiles, boats, aircraft, and so on. The travel needs of many native northerners have escalated dramatically, too, as families disperse, wages must be earned in remote places, negotiations must be continued with southern firms and government officials, and game is sought farther from home. Needs and expectations relating to education, health care, and other social services likewise have increased.

This new level of consumption of food, clothing, materials for shelter, utilities, machinery, and energy is not being paid for entirely from local resources. Fish, furs, marine mammals, caribou, moose, fuel wood, and other local resources are economically and nutritionally significant nearly every-

where in the vast arctic and subarctic region. However, no northern community of which I am aware could continue present patterns of consumption without income from a) wages earned from jobs in nonrenewable resource extraction projects, b) wages from government jobs, c) welfare payments, and d) transfer payments, such as for settlement of land claims. Thus, northern communities today are dependent upon what Borgstrom (1965) called "invisible acreage" far from familiar home country, as well as the visible acreage of land from which they harvest country food and other necessities. Some fraction of their income stems from the mining of fossil fuels and minerals and hence is not indefinitely available.

How much of the sustainable production capacity (of food and furs, primarily) of northern lands and seas is now being harvested? This question, which turns out to be very complex, has not received comprehensive study. In the most courageous attempt yet made to quantify supply and use of country food, Fuller and Hubert (1981) concluded that in 1978-79 residents of the Northwest Territories took about 75% of the available supply of game but only 25% of the potential harvest of marine and freshwater fish. They concluded that "it would be unwise to count on more than a doubling of the numbers that can ever be supported on wild fish and game if the intensity of use remains at about the same level as it is now." Essentially all of this available increment, they predict, will be used up in 20 years by projected population increases. Fuller and Hubert treat the supply as a rather fixed number determined by ecological features of the north. The variables are human population and per-capita consumption rates.

No comparable estimates have been published for Yukon and Alaska, as far as I am aware. Although Yukon Territory has a milder climate than the Northwest Territories, and hence a somewhat higher per-area productivity, it also has three times as many people per square mile, and may be no less closely harvested. In Alaska there is extreme political competition between subsistence and recreational users for big game resources, which argues that there is little unharvested surplus of those species. Marine fish resources are enormous in comparison with present domestic demand, but export-based fisheries capture the biological "surplus" of many species rather effectively (salmon, large crabs, halibut, pollock, and other commercial species).

Exactly where northern human populations stand in relation to the carrying capacity of presently utilized local renewable resources, therefore, is still uncertain. When one listens to northern residents discuss fish and game, it is not hard to gain the impression that key resources are in uncomfortably short supply. At the same time, native and non-native populations are increasing all over the north of Canada and Alaska. Both perceptions and realities of resource shortages seem likely to intensify.

Given this situation, what options are open to residents of small northern communities? The choices in theory include at least the following:

- 1) reduce per-capita consumption;
- 2) reduce population by drastically lowering birth rates;

- 3) reduce population through emigration;
- 4) increase the per-acre yields of northern renewable resources;
- 5) develop markets for presently underutilized local resources;
- 6) exploit nonrenewable resources within the region;
- 7) export hydroelectric energy; and
- 8) obtain payments for the taking of native lands and resources; invest in nonlocal projects.

No one of these itself is a socially acceptable and sufficient solution. Several in combination could provide at least temporary relief. But the nature of these "solutions" is complex, and striving to implement one or more of them predictably will bring new problems. A few comments are offered here to raise typical issues.

Despite the low (by southern standards) level of total per-capita consumption of resources by northerners, certain elements of that consumption could be reduced. Housing improvements could cut fuel consumption costs by 75% or more, for example, and there are many in the south who have discovered that life without television isn't all that bad. No reduction in individual consumption, however, accomplishes anything if population continues to grow.

Population reduction, too, is possible, though fraught with problems. If birth rates dropped far enough to turn today's rapid population increase into a decrease quickly enough to correct the growing resources: population disparity, the scarcity of children would drastically affect the entire society. Even if population levels voluntarily were brought in balance with the carrying capacity of visible acreage, how could northerners gain a guarantee that carrying capacity would not be reduced even further by southern exploitation of the land? Reduction of numbers through emigration, too, is as chimerical as it is socially disruptive. Arguably, there is nowhere a northern native can go where carrying capacity has not been overshot already (Catton, 1980). In this sense, any emigration of southerners to the north or vice versa is merely a geographic displacement of the problem.

Increasing yields of harvestable species, from a human perspective, is a positive step because it permanently (?) increases carrying capacity (though perhaps at the expense of other species displaced from the solar energy stream). However, techniques for agriculture, mariculture, animal husbandry, and tree growing are in rudimentary stages of development in boreal, arctic tundra, and northern oceanic environments. To use known techniques successfully and to evolve new ones rapidly would require substantial investment capital and a very high order of scientific and managerial skills, to say nothing of the changed social organization required (Usher, 1981).

There are cottage industries now in the north and presumably more will be started. These cottage industries (art marketing, handicraft manufacture, tourist guiding, meat export, etc.) have important advantages for northern settlements. Their small scale, decentralized nature, low capital requirement, and simple organization fit more easily into understood

patterns of behaviour and community life than do heavy manufacture or large mining and energy projects. Nevertheless, many settlements seem to have few opportunities for new cottage industries. Rarely do the known opportunities offer a realistic chance for local people to displace welfare and remote-site wage earnings. Given increasing populations, foreseeable income from cottage industries will only temporarily keep local residents from being worse off than they are now.

The north has known and presumed reserves of fuel, energy, and mineral resources of great value to southerners. If northerners could capture most of the rents from these resources, they would be wealthier while the resources lasted. At this time native northerners secure only a small fraction of these rents, which come as wages and as payments from governments that share in the resource income stream. They could enlarge this share by becoming owners of resources (which Alaska natives became, to an unknown but probably modest degree, in 1971) or if they had enough capital to bid on development leases offered by landowners. The major drawbacks to this strategy are 1) the resources are exhaustible and hence only temporarily increase carrying capacity; 2) most northern settlements have little hope of ever having the enormous capital to buy into the exploitation process or of becoming large-scale resource owners; 3) substantial involvement in large-scale resource projects increases dependence on remote societies and decreases local self-determination.

Hydroelectric power development has all of these problems except that hydropower generation is sustainable as long as the river runs. (Even this must be qualified. Dams may have a long, but nonetheless finite, life. They must be rebuilt. Also, markets are not guaranteed but must be kept secure in a competitive, technologically sophisticated field.) Because of the cost of transmitting electrical energy, only a fraction of the north's potential hydro sites is realistically exploitable in the foreseeable future.

The scale of economic projects and its relationship to northern community development warrants discussion. Any such enterprise has a profitability threshold: a size that must be surpassed if a net profit is to be obtained. (There often is a maximum size, too, beyond which profits disappear. This will be ignored here, as it is not relevant.) This threshold may move up or down as new competition, new cost/price relationships, technologic improvements, and obsolescence have their effect. At the same time, one can imagine a continuum of degree of local control at one end of which are small enterprises totally within a northern settlement's power to finance and manage and at the other end of which are activities far too large for significant participation or control. Certain kinds of projects — labor intensive, low in capital requirements, and involving simple equipment and simple production/marketing organization — are profitable at a small scale under local control. Some kinds of commercial fishing, guiding, tourist services, farming, and forestry may fit this pattern. Other enterprises are not profitable unless done in a big way. They require large capital inputs and complex interactions with regulatory agencies, competitors, and remote market structures. For the small nor-

thern community these are out of reach in terms of investment capability and present technical skill. Perhaps more critically, they are unfavorable because they inevitably entail loss of decision-making ability to distant firms and governments. Large hydro, petroleum, and most mineral (except precious metal mining) projects are in this category.

CONCLUDING COMMENT

The dilemma of people whose homes are the small, scattered villages of the northern forest and Arctic is not uniquely theirs. Many settlements of the tropical forests and subtropical arid lands of the world confront rising population, a fast-shrinking traditional resource base, and inescapable dominance by a distant but powerful "other." Many of these people, too — some of whom live more wretched lives, by far, than any northern native — are wracked by anomie, helplessness, social disintegration, and all of their symptoms such as drugs, suicide, and mental illness. And, except for their vastly higher consumption of material goods, are ordinary citizens of the world's industrial nations immune from these problems?

I have tried in this essay to describe a social situation from an ecological perspective. No prescriptions have been attempted. It might not be amiss, however, to end with an opinion about the most hopeful direction for northern residents to examine in their social choices.

A viable community is one that perceives itself as an entity at least somewhat different from all others, that wishes to retain its uniqueness, that looks with hope toward the future, and that believes it can make decisions and take action to correct perceived ills. Community development, I think, is any change that strengthens viability. The ecological relationships of a community with its home landscape and with the visible and invisible resource pools from which it draws sustenance play an extremely important part in maintaining that viability over time. Changes in those relationships that tend to increase a sense of self, a sense of hope, and a sense of self-determination are "development." Those that do not are dangerous and delusory, whatever short-term wealth they may promise. With those as basic criteria for testing all proposed community actions, some clear preferences begin to show among the eight courses that I suggested earlier might be open to northern residents.

The two pillars on which a structure of development strategies may be built are, first, adopting behaviors that lead, in socially acceptable ways, to stabilization of permanently resident native and nonnative northern populations; and second, protecting the capacity of northern land and seascapes to produce traditional renewable resources.

The present number of inhabitants of the circumpolar north is, according to Armstrong (1978), about 9 million, of which roughly 8 million are not native to the region. The Soviet north has about 6.7 million of the total; it and the Scandinavian arctic/subarctic lands are far more densely settled than northern North America. By far the majority of nonnatives — and hence a majority of all northerners — are in the north to remove and

transport mineral resources southward. Since these resources are nonrenewing, this part of the population can be considered temporary. While they are there, however, these "temporary" residents (some stay all their lives, some only a few weeks) add to the pressures placed on northern ecosystems. They add a pollution burden to air and water, degrade animal habitats, harvest some of the annual timber, fish, and game production, and hasten erosion. In short, they use up some of the north's limited carrying capacity, which might be strained if called on to sustain just the demands of permanent residents. Part of a population policy for the north, as Armstrong (1976) suggested, should be to admit that mines and oil fields have short lives, to build mining settlements with an eye toward dismantlement, and to provide labor through the shift method in which workers rotate fairly rapidly in and out of the north. Combined with careful controls on the interactions of temporary residents with northern landscapes and ecosystems, this would go a long way toward a more realistic long-term population/resource ratio in the north.

The need for vigorous protection of northern ecosystems to allow continued use by local people has been reiterated too often to bear yet another repetition. I will comment, however, that the importance of doing so transcends the economic needs of today's residents. It seems to me that northerners today feel heavily besieged. To be secure in knowing that they still have access to caribou, seals, char, whitefish, moose, or even whales, and that for some a hunting-gathering life is still possible, would seem extremely valuable to northern people. That cultural consonance alone might make other stresses of life far more tolerable. In the long run, maintaining ecosystems and the cultural skills to tap them is a kind of insurance against the exhaustion of nonrenewable resources or the collapse of the industrial society so heavily dependent on them — whichever comes first. If one must buy a ticket for the Titanic, a personal life raft is a good thing to have in hand.

It would seem sensible, too, for northern people to look seriously and with dedication to the possibilities of small-scale agriculture (Dearborn, 1979) and mariculture as ways of increasing regional carrying capacities. It would be wise for governments to increase their assistance in these directions far beyond the efforts now being made and to make sure that their goals are to insure local leadership and control, not to promote outsized projects dominated by heavy dependence on imported technologies and energy. I recognize that willows would be displaced by potatoes (to cite one homely example) and that the ecologic cost of rechanneling present energy flows in marine or terrestrial systems is not zero. Nevertheless, such enterprises, sensitively planned and of practical size for a small community, should not seriously disrupt ecosystem function on a significant scale.

Finally, expansion of small commercial enterprises based on the sale of surplus renewable resources is both possible and desirable for northern communities. The success of Cape Dorset art works and Bering Sea Inuit ivory carvings in southern markets exemplifies the opportunities. A fertile area for new enterprise is in guiding visitors (scientific parties, recreationists, etc.). This low-capital venture should yield a

good profit to the wise manager, put familiar skills to work, and be easy on the countryside and its resources. I cannot gauge the economic volume that such cottage industries could generate, though it is probably modest on average. As one of several positive steps in northern community development, however, development of these enterprises should not be neglected.

Like people everywhere, northerners have to come to understand the fundamental dichotomy between renewable and exhaustible resources (ignoring, in this essay, the fact that not all resources fall clearly into one or the other category). The enduring core of a community can only be maintained by the use and care of renewable resources. A community need not turn its back upon — if indeed it can choose to do so at all — the exploitation of exhaustible resources, but it must participate only with its eyes open. The key is to be prepared to cope with the downturn as well as the upsurge. Among other things, this means to minimize the size of the temporary population, to minimize investments sunk into an infrastructure that lasts longer than demand (and ability to pay), to protect the renewable resource base, and to invest rents from nonrenewable resource exploitation in the sustainable core of the community and its environment. Perhaps most difficult but critical is the need to avoid losing local self-determinative capabilities to outside interests.

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