south, man will continue to live in the closest contact with the natural environment. His success will depend as much upon the sophistication of his ecological knowledge as upon his technical competence to respond.[1]

1. McTaggart Cowan, "The Ecology of the North: Knowledge Is the Key to Sane Development," *Science Forum*, 2 (1969), 8.

Arctic Petroleum Development and Environmental Degradation

ROBERT B. WEEDEN

IN preparing to discuss this subject, I began to collect tangible evidence of ecologically wasteful and abusive practices in the Arctic. Frank memoranda between members of resource agencies, reports from pilots and renegade oil-field workers, pictures of garbage behind the mess halls, barrels drifting on lakes, eroding cat trails, and the classic blunder of a Geophysical Services bulldozer operator who carved the initials of his outfit onto the tundra in letters 200 feet high—all these went into my file. Then I changed my mind. For one thing, it was clear that arctic science lived in a glass house as far as vehicle tracks and

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debris were concerned. Mainly, however, I saw that no purpose would be served by presenting a diatribe against the petroleum industry. It is much more appropriate and profitable to describe the context in which I view the melange of changes, blatant and subtle, that comprise the phenomenon called "environmental degradation." This perspective is mostly in the form of questions but I will also make a suggestion or two that may help protect the public interest in our fabulous arctic resources.

Degradation is the process of being lowered in value. Environmental degradation, therefore, encompasses all things that lessen the value of air, water, soil, the biosphere, or human opportunity. "Environmental degradation" can be defined only in relation to value systems of a person, company, or agency. There is no single scale of measurement such as economists use to measure Gross National Product or as is used to measure earthquakes. As an example, when a tracked vehicle disturbs the vegetative blanket that insulates the tundra soil, a series of local physical and biological changes occur that result in a visible and long-lasting trail. Whether this trail is "damage" depends entirely whether one views it as an intrusion into a former wilderness or simply as a convenient way of finding your way to a drill site.

Second, environmental degradation is a process—an ongoing, often cumulative complex of events that can, nevertheless, occasionally be reversed (as when eroding trails are covered again by pioneering vegetation).

Third, the entity "environmental degradation" is the sum of an almost infinite list of changes, positive and negative in sign, of varying strengths. The individual changes are much easier to quantify than the totality of events.

In the Arctic one can sense the gathering momentum of two kinds of environmental devaluation: the diminution of biotic productivity and the attendant but distinguishable loss of opportunity.

Some losses of biologic productivity are inevitable in the strict sense. Even with the most careful, environmentally conscious oil-field development, there is no way to produce life under a thick pad of gravel such as will underlie camps, airstrips, roads, storage areas, and drill locations. In addition, there is little chance that a fully developed arctic oil field will support populations of wolves, peregrines, grizzlies, caribou, and wolverines. There are too many physical barriers and too much noise and traffic.

Other losses—and these, in practice, are the major ones—are at least theoretically reducible, since they result from carelessness, accident, ignorance, or inappropriate exploration and development systems. The widely discussed erosion scars laid down like slug spoor behind summer cat trains are an obvious example. If no off-road travel were allowed except when the ground was thoroughly frozen and protected by snow, this damage would be drastically reduced. (A start has been made in this direction.) If only aerial transport were allowed in seismic and other cross-country operations, this trailing would be eliminated entirely. If companies shared their seismic information, millions of dollars worth of effort and a big percentage of the visible degradation of the tundra would be avoided.

Oil spills are another example of sources of environmental damage that could be reduced or (theoretically) avoided. As Bartonek put it in his recent report on potential dangers to waterfowl, "Leak is the key word in describing the impact of oil development on birds of Alaska's Arctic Slope. Without leaks the impact could be tolerable; with leaks the impact could be disastrous."[1] So far the only reported oil spills on the Arctic Slope are from mishandling of oil brought in from the south: discarded fuel barrels and leaking fuel storage tanks. Oil is undesirable and destructive when loose in any environment, but in the North the slow rates of petroleum degradation could multiply its effects. As one example, oil spreading under the arctic ice pack could destroy biotic production over a large area, since planktonic conversions of solar energy—the entire basis of the oceanic food chain—occur in the few inches of water below the ice.

Among the predictable sources of reduced biotic production in the North Slope impact area are (1) excessive harvest of highly prized species such as grizzlies, wolves, arctic fox, and wolverines; (2) reduction of moose stocks along heavily traveled rivers

1. J. C. Bartonek, "Arctic Slope and Trans-Alaska Pipeline Task Force Report: The Bird Resources of Alaska's Arctic Slope and Petroleum Development," Northern Prairie Wildlife Research Center, Jamestown, North Dakota, September 30, 1969. Mimeographed.

such as the Sagavanirktok and Anaktuvuk; (3) local dispersal of all sheep from ranges around lakes and other access points; (4) disturbance of raptor nest sites, especially of peregrines and gyrfalcons; (5) loss of grazing area for caribou; (6) direct losses of waterfowl, especially in areas of seasonal concentration such as molting lakes, from oil spills; (7) overall loss of productivity of aquatic ecosystems from oil spills and excessive sewage or other waste disposal; (8) destruction of spawning channels from gravel removals and siltation; (9) excessive disturbance of caribou on their calving grounds; (10) erosion or vegetation damage from earth-moving and travel activities.

Oil-field development in the central Alaskan Arctic will doubtlessly increase opportunities for some ventures such as metallic mineral exploration and the guiding of hunters and fishermen. We should recognize that the same development eliminates other opportunities. I think especially of the impossibility of establishing an arctic wilderness area in a place where oil is being sought or extracted. America possesses only one area of arctic tundra, and that is the North Slope of the Brooks Range and the Arctic Plain. Even now it may be too late to dedicate any significant portion of the region to wilderness preservation. In his testimony to the Senate Committee on Interior and Insular Affairs on October 16, 1969, Dr. Tom Cade (Research Director, Laboratory of Ornithology, Cornell University) said, "Except in some of the mountain fastnesses of the Brooks Range, I doubt that one can find a 100-square-mile plot of ground east of the Colville River —including the Arctic Wildlife Range—that does not show some irreparable sign of man's activities."

I think, too, of the diminishing degrees of freedom for natural sciences in the Arctic; as just one example, it is no longer possible to set out sample units for long-term ecological or phytosociological research, with any confidence that they will remain undisturbed, anywhere between the Canning and lower Colville rivers. Behavioral studies of large birds or mammals are nearly impossible in this area because of the frequent disturbance from seismic shots, cat trains, helicopters, Nodwells, drilling activities, gravel hauling, and so on.

Recognizing the reduced production and foregone opportunities accompanying industrialization of the North, we must examine our attitudes toward the new developments to make sure that regional land planning reflects national goals. Three basic questions face arctic land managers. First, should any oil development at all be allowed on a particular planning unit? Second, what rates of petroleum development are best? And finally, what techniques of exploration, extraction, and transportation should be used? My position is that because arctic oil is a public resource under public domain, the public itself, through government, has the right to answer these questions.

I have no illusions about how often we will bar the gates to oil development. Despite Prudhoe, however, where government did not even build a gate, let alone decide whether to open or close it, I think the question has relevance for the future. According to the petroleum industry, all of Alaska's North Slope, most of Arctic Canada, and large parts of the Arctic Ocean may be underlain by gas and oil. Surely it is feasible in that huge expanse to post some areas "off limits" to oil exploration and development when this is justified by high-value wildlife, scientific, scenic, or recreational resources. These reserves might serve for ten, twenty, or fifty years while oil development proceeds elsewhere. Periodic appraisals of the industry and the reservations would show whether changes in land-use allocation are necessary.

There are a number of advantages to this strategy. One is flexibility—the retention of freedom of choice, a prime element in modern land planning. If we decide to forego oil production in favor of letting a piece of tundra continue its modest yearly production of caribou, peregrines, flowers, recreation, and science, we can always change our minds. On the other hand, when an area is opened to oil development the biological and physical changes to the landscape and the inertia of massive capital investments result in a fixation of land use. We become locked into a pattern that defies change even in the face of totally different economics of the energy industries or attractive alternatives of land use.

Another advantage is that we may never need the oil under the reserved lands, and thus could save them from any industry-caused degradation. Oil may become as obsolete for energy in the near future as hay fields and woodlots are now. The economic life of arctic oil fields may be only twenty to thirty years, and if we are going to forfeit wilderness for one hundred years to pump oil for twenty, we should know it before leasing ground to the drillers.

The rate of petroleum development that is best for our nation is also a key question. Since the apparently huge oil reserves of the Arctic will significantly affect the flow of world trade, geopolitical factors are involved that are beyond my ken. Nevertheless our recent experience on the North Slope shows that the speed at which exploration and development occur has tremendous environmental implications. Much of the abuse of the landscape at Prudhoe Bay can be traced directly to the competition among companies to find and lease the best ground in the shortest possible time. The state of Alaska's haste to get in on the bonanza—as evidenced by the eleventh-hour selection of nearly 3 million acres south of the discovery area just before the federal land freeze went into effect and by the lease sale held September 10, 1969—has contributed to the problem.

The implication is that there has to be adequate control of the pace of development, and in my view, despite past governmental reluctance to exert this control, it is clearly through government that public interests must be protected. The initial decision to prospect for oil should be a public decision, based on a formulated land policy, a prior land classification, and a current study of fossil fuel demands. Following that decision, a joint government-industry exploration corporation should be established, perhaps patterned after Canada's Panarctic Oils, Ltd., venture. Perhaps a quasi-governmental organization as suggested by Garnsey for oil shale development and by Tussing and Erickson for mineral exploration in Alaska, should be formed.[2] Then exploration could proceed in a more orderly way, with complete sharing of geophysical and test-well data. When exploration is successful, oil-field development would proceed under a unitization plan. This process would eliminate competition during the

2. M. E. Garnsey, "Protecting the Public Interest in Oil Shale Development," *Natural Resources Journal*, New Mexico School of Law, 8, no. 4 (October 1968), 587–603. A. R. Tussing and G. K. Erickson, *Mining and Public Policy in Alaska*, Institute of Social, Economic, and Government Research Report no. 21 (College: University of Alaska, 1969) (see pp. 73–75: "Government Investment in Mining Enterprise").

exploration and drilling phases of petroleum development, mainly (in this context) as a means of environmental protection.

A rather important by-product of orderly, area-by-area exploration and development is that the pieces of ground held for later exploration will benefit from improved oil-field technology. If all of Arctic Alaska had been thoroughly explored between 1930 and 1960, the area would be a disgraceful mess. Seismic operations in those decades were routinely done with cats run with blades down. Improved technology and more governmental attention over the past year or two have already lessened the degradation of environment during exploration work. The development of hovercraft may lead to further improvements. Some day, in the near future, it may be possible for petroleum exploration to come and go leaving the land undamaged.

This leads logically to my third point, the question of operational techniques. An oil field can be a reasonably pleasant place to hunt moose or go canoeing—witness the intensively industrialized half of the Kenai National Moose Range. An oil field can be a comfortable, convenient place to do a bit of natural science. Whether it is or not depends largely on how much thought goes into field development. I will not go into detail about the sources of the problems or what can be done to solve them. I do wish to point out that everything done to protect the environment during oil-field development costs money. Some of the costs are borne by government (research, administration, enforcement of regulations) and some are absorbed by the petroleum companies. If the money is not spent to take care of the soil, water, vegetation, wildlife, and general appearance of the land, the costs of this environmental degradation are taken eventually out of the pockets of taxpayers as a whole. With Garrett Hardin I urge that as many of the costs of environmental protection and repair as possible be internalized within the industry.[3]

The best summary of my position on the relation between oil and other land uses in the Arctic was made by John Krutilla in his presentation to the Thirty-third North American Wildlife and Natural Resources Conference. Speaking especially of water resources, he said:

3. G. Hardin, "Finding Lemonade in Santa Barbara's Oil," *The Saturday Review*, May 10, 1969, pp. 18–21.

> We have learned that technological progress has carried us to the point where we no longer need to destroy natural environments which have either scientific research value or special characteristics required for specialized recreation activities, in order to increase the output of tangible goods and services. . . . While we can rely on technology to compensate for depletion of certain kinds of natural resources, we cannot rely on technological progress to increase the supply of natural environments which yield utility through direct personal contact. . . . Accordingly, if we wish to leave our heirs the most valuable legacy, we ought to make provision for those assets which appreciate with the passage of time. This we can do with an active policy of intelligent and discriminating preservation of existing natural environments which have characteristics required to serve scientific research objectives and the entire gamut of outdoor recreation wants.[4]

After some months of lively, if unstructured, discussion, some of the essential features of an environmental policy for Alaskan oil development seem to have emerged.

The first need is to take the initiative for exploring new areas out of the hands of private industry. Federal and state government must exercise their authority over public resources on public lands, and acknowledge their fundamental responsibility to the public, not to corporate interests. The first use of this authority should be to call a halt to all oil and gas exploration outside of present lease areas, patented ground, or claims, for a period sufficient to prepare a plan for orderly exploration.

Second, this orderly exploration must be a part of a major effort to plan for resource development in the whole state. A new, formal organization may well be needed to do this, since no existing entities have the budget, authority, or breadth of interest and composition to handle it. The best minds in Alaska and the nation should be committed to this task with appropriate fiscal support. Given a five-year period in which to work (perhaps through an extension of Public Land Order 4,582, the "land freeze" order, and supplementary actions), and by using private consultants and open public forums equally, this group could do much to alleviate the economic, social, and environmental wrongs being perpetrated under present "development" nonpolicy.

4. J. Krutilla, "Balancing Extractive Industries with Wildlife Habitat," Thirty-third North American Wildlife and Natural Resources Conference, March 12, 1968.

Third, public and private funds should be dedicated to a greatly expanded program of ecosystemic study of arctic and sub-arctic areas. The International Biological Program is one means, already in operation, to handle a major portion of this task, although I also see value in research support outside of the formalized IBP structure. The goal would be to understand environment, energy flows, and the functions of individual species well enough (under natural and disturbed conditions) to provide the basic underpinnings of later northern engineering and resource development.

Fourth, a means should be worked out by which government deals itself into the process of oil and mineral exploration so as to reduce waste and abuse of space, soil, vegetation, wildlife, and water during this phase of economic development. This was discussed earlier in this paper with references to more detailed studies of the mechanisms involved.

Fifth, but simultaneously with other steps, there should be a vastly stepped-up field investigation of areas that could be withheld temporarily or permanently from any type of development that would degrade their natural attributes. This statewide inventory would complement the land planning effort already mentioned. Between the two, it should be possible to propose a system of areas reserved for the whole spectrum of public uses (wilderness, scientific reserve, park, monument, wildlife refuge, wild river, etc.), covering representative units of all environments in the state. A plan for management level—local, university, state, federal, or combined—would be part of the output of the groups involved in the study.

Sixth, but very importantly, serious attention needs to be given to the policing aspects of protecting public interests in northern resource development. Thought should be given to a uniform regulatory system applying on any lands, whether state, borough, or federal. This would benefit industry as much as the public. Regulations should be adequate to carry out environmental policies (which means there must *be* policies) but not so as to constitute an "overkill." Enforcement should be simplified by reducing the number of agencies involved. Men doing the enforcing should be thoroughly experienced in arctic and sub-arctic environments: one of the obvious steps would be to encourage native people of the North to help protect their own lands and resources. Finally, the dollars allocated to this work should reflect the magnitude and importance of the task at hand; this is perhaps the most serious criticism to be leveled at the current state of affairs.

In conclusion I will simply state that we must devise and implement policies of northern development that maximize human opportunity, diversity of culture, choice of life-style, and breadth of economic base. Alaska is America's last chance to prove that we can love and understand nature as well as we cherish man and his technology.