FISH, WILDLIFE, PIPELINE: some perspective on protection

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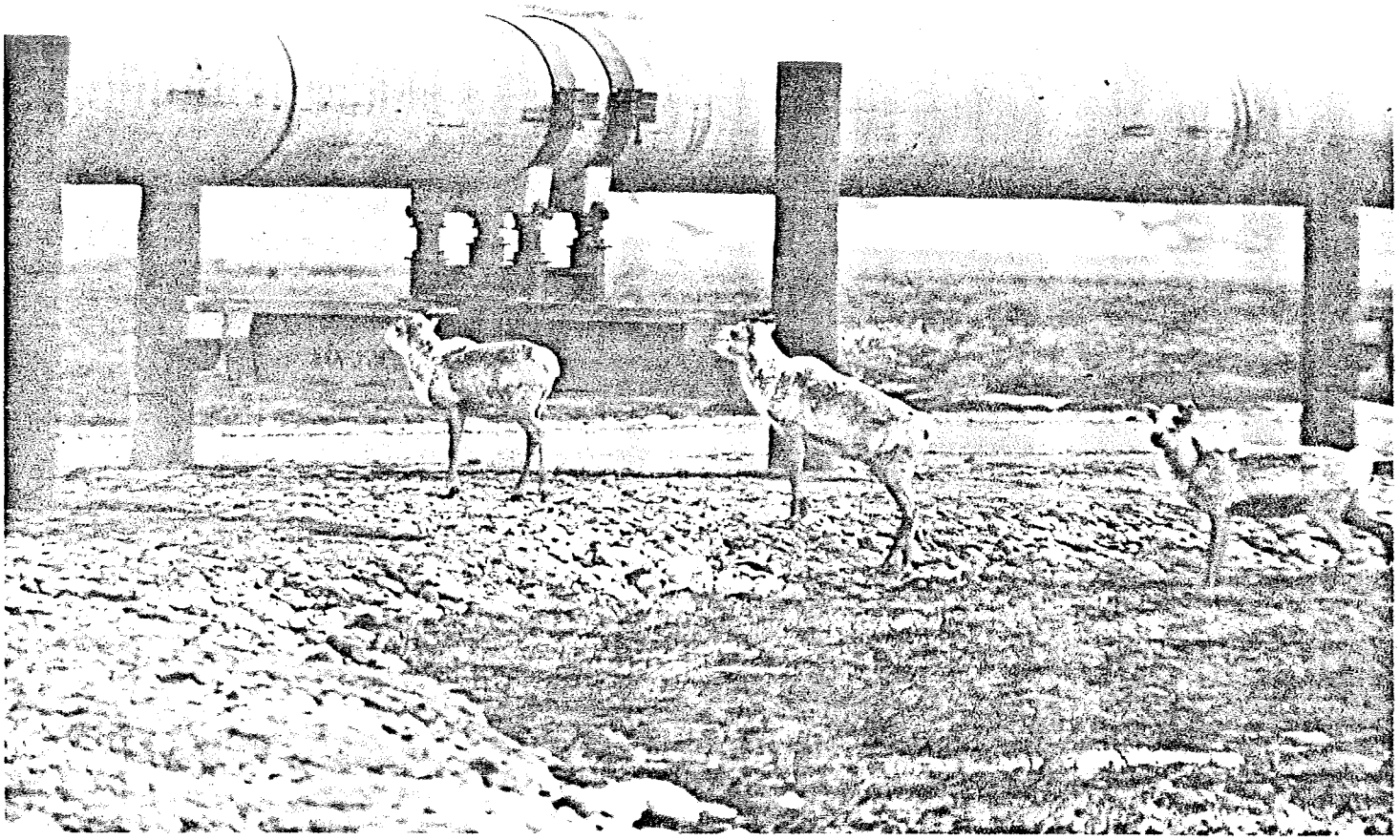
by Thomas A. Morehouse



Caribou confront the trans-Alaska pipeline. (Alaska Cooperative Wildlife Research Unit photo by Dan Roby.)

Seven years after oil began pumping through the trans-Alaska pipeline, strong opinion still exists about how well fish and wildlife were protected during construction of that pipeline. Before the pipeline was built, its possible effects on animals and fish along the route were among the most publicized and controversial aspects of the proposed project. Ultimately, a joint federal-state organization was established specifically to protect fish and wildlife during pipeline construction; that organization was part of broader monitoring systems established by both the federal and state governments to enforce technical and environmental standards the pipeline builders had agreed to meet.

Near the end of construction, in 1977, the U.S. Fish and Wildlife Service contracted with researchers at the University of Alaska's Institute of Social and Economic Research to study how effective the fish and wildlife protection organization had been, and what factors had influenced its effectiveness. This article summarizes some of the findings of the institute's detailed report, published in 1978.

The findings of this report are still of interest because the pipeline project revealed many difficulties and uncertainties of large-scale construction in the Arctic. No one knew exactly what conditions

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would be like along the 800-mile pipeline route, and government monitors, including fish and wildlife monitors, received little guidance on how to do their jobs. In many cases they learned as they went—and what they learned will be invaluable for any future large projects in Alaska. The researchers looked mainly at the federal government's involvement in the planning and building of the pipeline, but also to some extent at state planning and surveillance activities.

The Planning Period: 1969-1973

In 1969 a group of oil companies proposed to build a pipeline that would carry North Slope oil 800 miles south across Alaska to the port of Valdez. Along the way the pipeline would cross large areas of permafrost, several mountain faults, hundreds of rivers and streams, and habitats of dozens of kinds of wildlife. It would be partly above and partly below ground; it would have to be capable of withstanding temperature extremes of from more than 50 degrees below zero to 90 degrees above. The proposed pipeline would be the largest privately financed project in history.

The oil companies needed federal and state approval of the massive project; about two-thirds of the land the pipeline would cross was federal and the remainder state. But a number of national environmental organizations opposed the project, maintaining that its potential effects on Alaska's lands and waters were impossible to gauge. Court suits brought by these organizations blocked federal approval of the project for four years, until Congress passed the Trans-Alaska Pipeline Authorization Act in late 1973. During this delay, government pipeline planning and policy making was dominated by two basic forces: conflicts between energy development and environmental protection objectives, and jurisdictional claims and counterclaims among government agencies at both state and federal levels. Also involved were questions of the relative extent and limits of federal and state government authority and differing philosophies of government responsibility for the regulation of private industrial development. The general outcomes of this complex of forces were:

1. Energy development objectives had priority over, but did not exclude, environmental protection objectives.
2. Agencies at both federal and state levels whose capabilities and interests were most consistent with the development priority tended to dominate in the pipeline planning and construction surveillance processes.
3. The federal government effectively asserted primary control over pipeline surveillance matters, and the State of Alaska played a secondary role—except in the area of fish and wildlife protection.
4. Government responses to the oil companies' interests in pipeline construction tended overall to be facilitative, but government also demanded assurance of the structural integrity of the pipeline, which, in turn, helped assure longer-run environmental integrity.

Early on, the Department of the Interior became the lead agency for pipeline planning. Interior's Bureau of Land Management (BLM), with jurisdiction over federal lands along the prospective right-of-way, began working in 1969 in Alaska with the oil companies planning the project.

Reflecting an early federal government emphasis on protecting the environment during pipeline construction, the BLM's resource management staff led an interagency effort in 1969 to prepare environmental "stipulations" that the pipeline builders were to meet in construction and operation of the line. Representatives of fish and wildlife agencies were involved in writing these stipulations and in the next several years also took part in preparing the environmental impact statement required for the pipeline project under the National Environmental Policy Act.

But even as the environmental stipulations were being written, the seriousness of permafrost, seismic, river crossing and other technical-engineering problems became ever more apparent, and Interior's U.S. Geological Survey was drawn increasingly into pipeline planning. In 1970, it was determined that a set of technical stipulations should be developed in addition to the environmental stipulations, and government emphasis shifted to basic technical problems affecting pipeline integrity. Also, assuring pipeline integrity came to be seen as the best means of protecting the environment in the long run. This shift in emphasis led to fish and wildlife agencies in Alaska having less active and direct roles in the planning process than they had had in 1969 and 1970, before engineering problems overshadowed more subtle environmental concerns.

Construction Period: 1974-1977

When the federal government approved construction of the pipeline, the Interior Department created the Alaska Pipeline Office (APO), and the state established the State Pipeline Coordinator's Office (SPCO) to oversee construction across state lands. In early 1974, the state and federal governments and the oil companies making up Alyeska Pipeline Service Company signed right-of-way agreements outlining technical and environmental stipulations that the pipeline builders were to meet. The state and federal governments also signed a cooperative agreement calling for joint protection of fish and wildlife along the route. This provision led to the formation in May 1974 of the Joint Fish and Wildlife Advisory Team (JFWAT), made up of biologists from the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Bureau of Land Management.

JFWAT was to advise the two broader surveillance organizations on how best to protect fish and wildlife during pipeline construction. The team's office and field staffs could make recommendations to

the APO and SPCO, but had no authority to direct Alyeska to take action. All positions of authority in the Alaska Pipeline Office during construction were held by engineers who determined if Alyeska was meeting required standards and, if not, what actions Alyeska should be directed to take.

Although advisory, the biologists brought with them some of the statutory authority of their home agencies, and this authority—particularly the Alaska Department of Fish and Game's authority to restrict activities in anadromous fish streams—together with the team's unique joint structure that placed it somewhere between the separate surveillance organizations, gave the team a degree of independence from those it advised.

Field staffs of the Alaska Pipeline Office and the State Pipeline Coordinator's Office oversaw daily construction. The authorized officer's field representatives (AOFRs) were responsible for enforcing technical and environmental stipulations of the federal right-of-way agreement, but their duties also included assuring that the pipeline was build "promptly" and weighing "environmental amenities and values with economic practicalities so as to be consistent with applicable national policies."[1] The state field surveillance officers (FSOs) had similar responsibilities on state lands the pipeline crossed.

These field chiefs and their fish and wildlife advisors were given copies of the state and federal right-of-way agreements and told to base field decisions on the provisions of these documents.[2]

The heads of the APO and SPCO could approve deviations from many of these stipulations if they felt field conditions justified such deviations.

Government field monitors hired early in construction received little instruction on interpreting and applying the environmental provisions and stipulations of the right-of-way agreements.[3] As one AOFR explained, "Nobody knew enough to give us those kinds of instructions." A monitor for the Joint Fish and Wildlife Advisory Team recalled that "my boss pointed to a map and said, 'You have this much of Alaska to minimize impact on.' " Therefore, federal and state monitors used their own judgments based on experience in deciding what constituted a "minimum" effect on fish and wildlife, what effects would be avoided, and what measures the pipeline builders should be required to take to protect resources along the route.

The AOFRs and JFWAT field monitors met regularly with their supervisors in Anchorage to discuss questions of interpretation and applications of stipulations and to establish uniform policies, but the monitors maintain that individual judgments played significant roles in monitoring throughout construction.[3]

The stipulations that were most relevant to the fish and wildlife monitors were ones that directed the pipeline builders to "provide uninterrupted and safe passage of fish" and "assure free passage and movement of big game animals" during construction and after the pipe was in place. Below we describe, based on interviews with AOFRs and their JFWAT advisors, problems that occurred at stream crossings and in construction of big game crossings and the different ways in which the government monitors assessed these problems.

STREAM CROSSINGS

The trans-Alaska pipeline and the 360-mile North Slope haul road cross about 1,000 streams and rivers, roughly half of these fish streams.[4] Because the pipeline, work pad, haul road, access roads, and materials sites crossed or were near such a large number of fish streams, the field staff of JFWAT spent much of its time monitoring effects of construction on water systems along the route. Advisors cited silting of rivers and streams, improperly constructed and incorrectly used low-water crossings, improperly placed or inadequately sized culverts in streams, and erosion as common problems.[5]

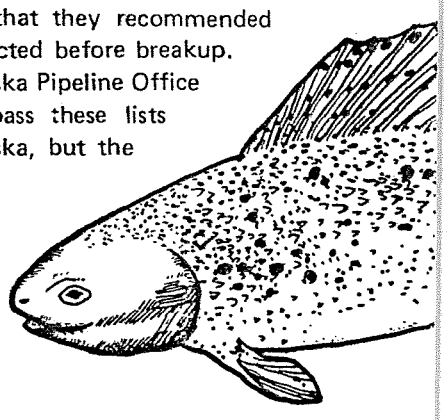
Most of the problems reported by JFWAT occurred when the work pad or haul road crossed streams, rather than when the pipe itself was installed across streams or rivers. Problems with culverts and low water crossings that JFWAT reported did not meet fish passage requirements were sometimes not corrected for as long as two years.

Researchers asked AOFRs and JFWAT monitors why so many problems occurred when the pipeline system crossed small streams and why the problems took so long to solve.

Federal and state biologists said many of the common problems at stream crossings originally occurred because so little was known about a number of the streams, particularly those north of the Yukon River. When Alyeska submitted, and APO (with JFWAT review) approved, plans for drainage structures at streams, the structures were based on very limited knowledge about individual characteristics of hundreds of streams along the route. More information about these streams was gathered during construction.

But JFWAT monitors and AOFRs cited many reasons why problems at some small stream crossings persisted throughout much of construction. JFWAT monitors attributed the persistent problems to the following reasons:

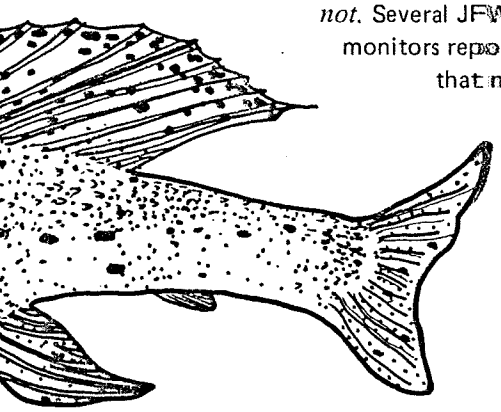
1. *Many AOFRs gave priority to pipeline construction and were unwilling to press Alyeska to correct fish passage problems within the time JFWAT asked.* JFWAT monitors reported that each year they prepared lists of items—drainage structures blocking fish passage, for example—that they recommended be corrected before breakup. The Alaska Pipeline Office would pass these lists to Alyeska, but the pipeline builders often did not complete the work by the designated date. Fish and wildlife advisors noted that several AOFRs made frequent reference to the fact that "Congress had mandated" that the pipeline be built "expeditiously" and asked the JFWAT advisors to show that "irreparable damage" to fish or habitat would occur if the work was not done by the designated time. Said a JFWAT monitor, "We were always on the defensive, always being asked to 'prove' what damage would occur if certain work wasn't done in a timely manner." Another JFWAT monitor reported, "One AOFR told me he felt the pipeline should be built first, and drainage structures corrected later."



2. *Size of a stream and kinds of fish in the stream influenced how quickly many AOFRs would ask the pipeline builders to correct a fish passage block at a drainage structure.* Several JFWAT monitors noted that most AOFRs reacted more quickly to solve fish passage problems in a salmon spawning stream, for example, than in a stream known to contain only sculpin.

JFWAT monitors also reported that many AOFRs did not recognize the importance of very small fish streams as habitat. "We had trouble convincing AOFRs that a stream maybe 18 inches wide and a few feet deep is excellent fish habitat" and that the "better fish habitat" along the pipeline route is in the small streams rather than the large rivers. Another JFWAT monitor noted that an AOFR had expressed doubt that a stream dry during certain times of the year could be an important fish stream.

3. *Obvious fish blocks usually got quick attention from AOFRs; more subtle effects of construction often did not.* Several JFWAT monitors reported that most



AOFRs would direct Alyeska to take some action "if they could actually see fish behind a culvert," whereas they would not press Alyeska "to remove work pad material that had eroded into a stream channel and altered the natural stream bottom."

4. *Pipeline builders sometimes had to return to the same stream several times to correct drainage structure inadequacies.* JFWAT monitors felt this situation occurred at some streams because: JFWAT/APO and Alyeska originally had inadequate knowledge about what kinds of drainage structures would be needed on some streams; Alyeska's quality control program failed to insure that culverts or low water crossings were installed according to approved designs; and some AOFRs did not require Alyeska to correct drainage structures "in a timely manner" when it became apparent they were not installed according to approved designs.

AOFRs, on the other hand, attributed problems that persisted at some small streams throughout much of construction to these reasons:

1. *If no "worsening environmental degradation" or "irreparable harm" was occurring because of a problem JFWAT documented at a small stream crossing, work on that crossing could be deferred.* As one AOFR explained, "Every year we would give Alyeska a list of items JFWAT recommended be completed before breakup, and Alyeska would say they would do it. Then they wouldn't do some of the items by breakup, and we would tell Alyeska to do the items before fall freezeup. Alyeska would say they would do them. Then they wouldn't... Why did we let them do this? Because we felt there was no worsening of environmental degradation, the pipeline had to be built, and we knew they would be required to do the work when construction slowed down."

Several AOFRs noted it was their responsibility "to balance environmental amenities and values with economic practicalities." One AOFR said, "I had to decide, is it warranted to ask Alyeska to bring a crew back from other work to replace this culvert now, or if the situation is not worsening, to let them wait until later?" AOFRs reported that they and JFWAT monitors frequently disagreed about whether "irreparable harm" to fish and habitat was occurring because of these delays, but that as chiefs of the government monitoring staff, the AOFRs had the responsibility for making decisions about what Alyeska would be required to do and when.

2. *JFWAT monitors sometimes asked for replacement of drainage structures based on insufficient evidence that the structure did not meet government requirements.* One AOFR reported that some JFWAT monitors "would measure speed of flow through a culvert following a heavy rain in an area of the pipeline where heavy rains happen only a couple of times a year, and the high flows last one or two days. If you measure the speed of flow at that time, can you really say the culvert is too small, that it's blocking fish?"

Several AOFRs also said that they were reluctant to direct Alyeska to replace a structure that had been previously approved by APO and JFWAT, unless JFWAT presented strong evidence that the approved structure did not meet government specifications. They had to decide, "Does the evidence justify asking Alyeska to spend $10,000 to replace that culvert that we had approved?" The AOFRs explained that in previous construction projects, government inspectors (primarily from the Corps of Engineers) whose actions could be proven to have unneccessarily cost a private construction contractor money or time had been held liable in courts of law for damages.

3. *Some stream crossings presented problems that were not easily solved, despite directions from the AOFRs and attempts by Alyeska.* As one AOFR said, "Many of these problems happened at streams that presented tough situations... the arctic is a place with unique engineering problems."

BIG GAME CROSSINGS

One of the most emotional issues debated by national environmental groups and the oil industry before construction began was whether elevated pipe would block movements of Alaska's big game animals, particularly caribou and moose. Caribou herds seasonally move across about 400 miles of the pipeline corridor. Moose are found along all but about the most northerly 75 miles of the pipeline route. Bison live in the Delta area, and brown and black bears inhabit many areas of the route. Based on some studies and observations, government biologists took the position that moose would probably cross under the pipe, if it were high enough, but that caribou would not; they assumed bears and bison would pass under the pipe.

Before work on the pipeline began, state and federal biologists agreed on standards for construction of big game crossings. These included:

> In areas occupied or traversed by moose or bison, pipe must be elevated to a minimum of 10 feet beween the top of the working pad and the bottom of the insulated pipe for

linear distance of 60 feet at intervals of approximately 1,000 feet. However, such elevated sections shall be adjusted to coincide with those locations that are most often used by moving moose and bison. . . In areas traversed by caribou, pipe must be buried to accommodate caribou movements.[6]

These standards were formally passed to Alyeska in March 1974, and the APO and the SPCO notified Alyeska later that the government monitoring agencies would enforce these standards. Early in 1974, biologists from state and federal agencies and Alyeska's environmental protection department designated several hundred locations in areas of elevated pipe where buried and elevated crossings would be needed. In August 1975, Alyeska issued a document listing these designated crossings; originally about 445 crossings were to be built, but several necessary changes demanded by field conditions increased that number to about 550.[7]

Records of APO and JFWAT show that of 224 crossings built in 1975, 88 elevated crossings were less than 10 feet high and of 326 built in 1976, 69 were too low.[8]

JFWAT attributed the incorrect construction of these big game crossings to failure of Alyeska's quality control program.[9] APO cited insufficient quality control and "many other field factors," including the fact that actual ground elevations were sometimes not as indicated on construction drawings.[10] In a December 1975 audit, Alyeska's quality assurance department reported designated crossings of "insufficient height" had been built due to "ground elevations not as depicted on plans; the computer program could not correct erroneous ground elevations; [the document listing the crossings] was not transmitted to construction until late in the effort; engineering allowed some changes of pad and/or pipeline elevations that did not consider wildlife crossing criteria; some were construction oversights."[11]

In the fall of 1975, JFWAT drew up a plan outlining how the pipeline builders could correct these crossings:

All errors of 0.5 feet or less may be corrected by excavating the work pad.

a. Errors of 0.5 feet or greater require that the split ring be reset to specifications, or

b. where consistent with environmental and technical stipulations the work pad may be excavated to meet the minimum . . . distance, or

c. where necessary both a. and b. above.

Errors that are not able to be corrected by excavation and/or resetting of the split ring may require reconstruction of the big game crossing.[12]

JFWAT took the position that unless geotechnical considerations precluded it, necessary excavation should be done across the width of the pad, rather than just under the pipe, to create a "window" for animals approaching the crossing.[13] APO and SPCO supported excavation across the width of the pad wherever possible.[13]

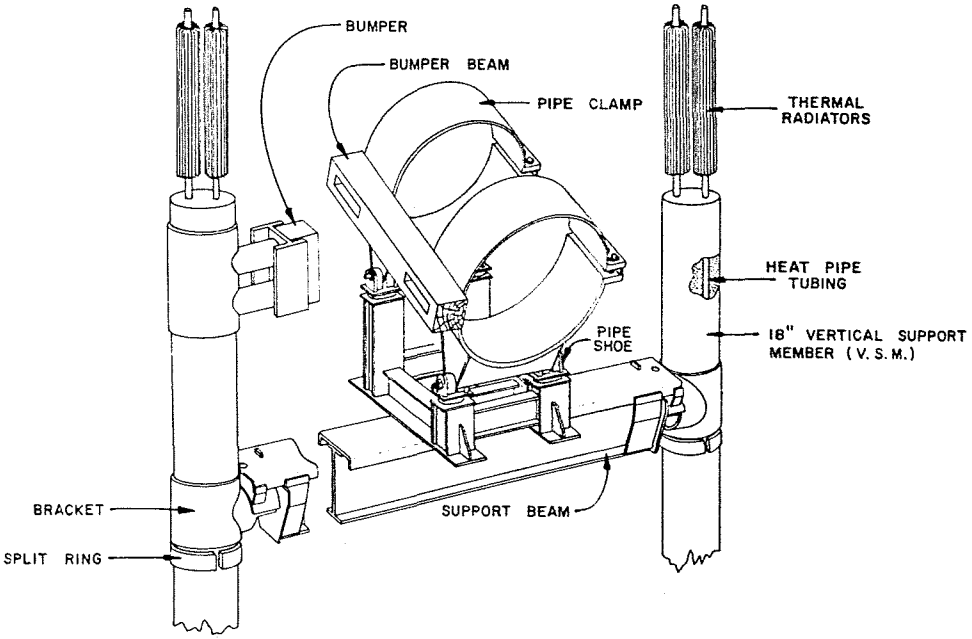
There were disagreements in the field between JFWAT and other government monitors on methods of excavation. Some monitors felt the need for a 10-foot high crossing did not justify substantial excavation of the work pad. They said this excavation might present hazards to the integrity of vertical support members and the pad's driving surface, and that some excavated crossings would require frequent maintenance. Others supported the JFWAT position that the need to maintain the required 10-foot height did justify excavation. Many of these questions were ultimately resolved by upper level JFWAT, APO, and SPCO officials meeting with representatives of Alyeska's environmental protection department.[14]

Most of the approximately 150 crossings that were built less than 10 feet high were corrected through excavation of the work pad; about 50 substitute crossings were designated.[15] In a few cases, split rings on vertical support members may have been raised before pipe was installed. (The height of the split ring on a vertical support member determines the height of installed pipe.) JFWAT reported that no installed pipe was raised at any of the crossings.

The two JFWAT wildlife biologists who worked closely with the big game crossing problems said that public discussion of the need for the crossings and the publicity that appeared concerning the improperly constructed ones strengthened their requests for remedial work on the crossings, particularly in 1976.[16] Even so, remedial work on some crossings was not done for a year or more after it was discovered that they were too low.

COMPARISONS AND CONTRASTS

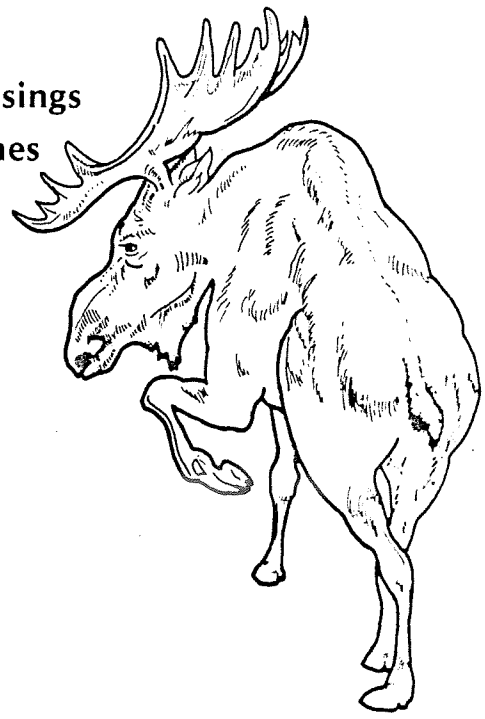
There were similarities and differences in the way problems that occurred at stream crossings and in construction of



ELEVATED PIPELINE INTERMEDIATE SUPPORT

(Drawing courtesy of Alyeska Pipeline Service Company.)

Correction of problems at stream crossings and big game crossings was sometimes delayed from one to two years.



game crossings were handled by the monitoring agencies.

1. Stream and river systems crossed by the pipeline are complex, and problems that occurred at some streams during construction involved many factors and required individual solutions. Many of these solutions involved judgments on the part of JFWAT monitors and AOFRs. What is the best way to solve this problem? When should it be solved? How much should we direct the pipeline builders to do? What is minimum impact? Problems at stream crossings were handled largely by field monitors day to day. Because JFWAT monitors frequently had little information about individual streams, their recommendations (particularly early in construction) were often based more on general biological judgment rather than detailed information on effects of construction on a stream. Some AOFRs accepted the fish and wildlife advisors' assessments of construction effects on streams and decided what Alyeska should be required to do and when.

2. Government standards for elevated big game crossings were simple—the crossings had to be 60 feet long and 10 feet high. Most of the crossings built incorrectly were constructed lower than the required height; they represented essentially a single set of problems that could be solved in a limited number of ways. Although there were differences in the way fish and wildlife advisors and other government field monitors viewed big game crossing problems, far less judgment was involved in monitoring these static crossings than in dealing with individual, ever-changing streams.

3. There were disagreements among JFWAT monitors and AOFRs about whether methods of correcting the low big game crossings were justified in light of construction and economic considerations, just as there were disagreements about whether proposed methods of correcting problems at stream crossings were justified in light of other considerations. JFWAT monitors saw their job primarily as protecting fish, wildlife, and habitat, while other government monitors saw their job as assuring that a sound pipeline was built as quickly and economically as possible, with minimum environmental damage. Given little instruction on interpretation and application of the stipulations, individual AOFRs and JFWAT monitors developed their own systems of monitoring based on education and past experience, and widely varying methods of handling fish and wildlife problems resulted.

4. Correction of problems at stream crossings and big game crossings was sometimes delayed from one to two years. AOFRs were willing to defer correction in favor of construction progress, if they judged "no worsening environmental degradation" or "irreparable damage" was occurring because of the delay, and other construction work was more critical. The question in the field became: What damage is actually occurring due to this situation? Since JFWAT monitors often had no detailed information about effects of construction on fish and wildlife, they relied largely on a strict interpretation of the stipulations and application of established criteria under varying circumstances. AOFRs often felt the stipulations were meant to be applied according to specific field conditions and questioned whether some stipulation violations reported by JFWAT were actually causing damage to the environment. Thus, JFWAT monitors were frequently asked to show what damage was occurring, rather than whether established criteria were being met.

CONCLUSIONS AND RECOMMENDATIONS

Participants in future development-surveillance projects will bring to their work a much higher level of awareness of potential problems and strategies for dealing with them as a result of the trans-Alaska pipeline experience.

The pipeline project represented a precedent-setting advancement in the art of integrating environmental values into a major development project. It presented an extraordinary learning opportunity for all participants, even though the pressures of construction time and scheduling imposed severe limits and constraints. Harsher critics of pipeline surveillance, who were also participants in it, were able to retain a positive sense of involvement:

> Despite the frenetic pace, physical strain, and a not-always cheery won-lost record, a number of JFWAT biologists, myself included, came around to enjoy the challenges of

the mammoth project, especially the feeling of being in the forefront of attempting something unprecedented in history. In particular, many of us have been quite acutely aware of the potential for influencing patterns and standards that might be adopted for future oil and gas pipeline construction surveillance in Alaska, Canada, and elsewhere.[17]

Substantive accomplishments of the fish and wildlife agencies show up as part of the general advancements made in incorporating environmental stipulations and criteria into the basic rules governing the design and construction of the pipeline project. Particularly significant among the fish- and wildlife-related elements of these new rules were the "construction windows" that specified permissible times for construction activity affecting particular habitats, standards for big game crossings, and stream-culvert velocity criteria. Even with the slippage between standards and performance, the formal incorporation, application, and monitoring of these new rules represents tangible progress in the state of the art.

Conclusions

National energy development priorities defined by the Administration and Congress, together with the high cost of delay, emphasized the need to bring Prudhoe Bay oil to U.S. markets as soon as possible.[18] Although construction was not officially mandated until passage of the Trans-Alaska Pipeline Authorization Act of 1973, there was a substantial de facto commitment to the project, and consequent momentum behind it, from an early point in the planning process. Further, apart from the legal blocks, the major obstacles to construction were technological; resolving permafrost, seismic, and other geotechnical problems was considered a key to preventing environmental damage. Thus, environmental protection was subordinated to the overriding construction goal, basic environmental problems were defined in engineering terms, and government surveillance authorities were reluctant to demand strict compliance with environmental stipulations, particularly where this might delay construction.

Major premises of the surveillance system were that Alyeska would design the pipeline and monitor its construction. Government's role could then be limited to reviewing Alyeska's designs and spot-checking the effectiveness of its quality assurance/quality control (QA/QC) program. Alyeska's performance was unsatisfactory, however, in both design and monitoring phases. Government planners found it necessary, therefore, to become deeply involved in Alyeska's design and engineering work prior to project authorization, and government monitors had to assume first-line environmental monitoring responsibilities. The effects were to concentrate government's attention on technical-engineering elements of the project and to overextend government staff in all aspects of monitoring, but particularly in fish and wildlife and other environmental protection activities.

Multiple agency involvement in pipeline planning and construction was unavoidable, given the existing statutory authorities and responsibilities of several federal and state agencies in areas of fish and wildlife management, pollution control, land management, pipeline safety, and others. Inefficiencies were mitigated, however, by concentrating authority in BLM's pipeline division during the planning period and in the Alaska Pipeline Office during the construction period. But the pattern of diverse, independent bases of authority served positive functions: It forced Interior policy makers (and Alyeska) to deal with and accommodate different values, interests, and objectives represented by the various agencies, and helped moderate the dominant technical-engineering and construction concerns. Fish and wildlife agencies, therefore, had to be taken into account and accommodated to a greater extent than might otherwise have been the case within a more fully consolidated surveillance system.

It was a particularly significant accomplishment on the part of the fish and wildlife agencies that JFWAT was established, developed its own identity, and served effectively as a vehicle for bringing home agency authority and influence to bear within the broader surveillance organization. Having the benefits and protective coverings of their home agencies, the JFWAT biologists were at the same time remarkably successful in shedding restrictive aspects of their separate agency affiliations and working together in a mutually supportive, close-knit group. Similarly, FWS officials remained persistent in promoting their interests, which had to be taken into account if not accommodated as often as those officials would have wished, during the planning phase.

In a more restrictive hierarchical system, with more concentrated attention to more exclusively defined development goals, it is unlikely that fish and wildlife protection values and interests would have the influence that they did in this case.

Recommendations

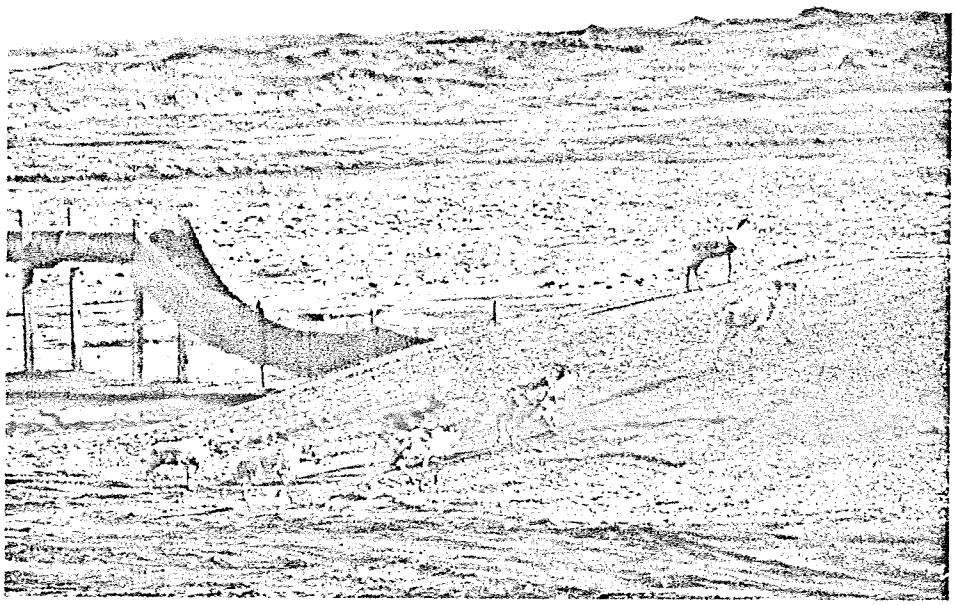
Surveillance Organization: JFWAT was an organizational anomaly that worked. Its location "between" the federal and state surveillance decision makers reinforced rather than weakened its influence, even though its formal role was advisory. JFWAT lacked engineering expertise and construction experience, however, and this weakened its credibility and aggravated communication problems between the biologists and the engineers.

Recommendations for a future surveillance organization are:

1. Organize the fish and wildlife protection functions within a joint federal-state team advisory to both federal and state surveillance authorities, as was done in this case.

2. Expand the joint team's jurisdiction to cover all related environmental protection functions; the team should include staff members detailed from the Environmental Protection Agency and the Alaska Department of Environmental Conservation.

3. Make civil engineering, hydrologic, and other appropriate technical expertise available in-house to the environmental protection team.



Caribou attempt an overpass crossing of a mock oil pipeline during a preliminary test of big game crossings. (Alaska Cooperative Wildlife Research Unit photo by Ken Child.)

4. Include design review, technical support, environmental monitoring, and technical evaluations in the joint environmental team's functions.

Monitor Training: Government monitors interpreted stipulations in different, inconsistent, and contradictory ways. Even when adequate information was available, different monitors assessed environmental effects differently, depending on the relative weights they placed on protecting a particular habitat, saving time and money, or simply avoiding unpleasant encounters, among other factors. The occasions of inconsistent and contradictory applications of the stipulations could be reduced in future projects.

Recommendations for training monitors for future large projects are:

1. Biologists and engineers should participate in a joint training program to familiarize each group with basic problems, processes, and techniques of the others' profession as applied to environmental monitoring of construction projects (e.g., construction at stream crossings and effects of construction-related disturbances on fish streams).

2. Monitors should receive training in stipulations enforcement. This training should include explanations of rationales for stipulations, representative case applications, methods of interpretation and uses of discretionary authority, and relationships between stipulations and existing statutes.

3. Monitors should be trained in methods of data collection and analysis, including sampling and testing (e.g., water velocities, turbidity), necessary to demonstrate serious violations of environmental stipulations.[19]

Monitoring Process: Fish and wildlife and other government monitors were sent to the field with little more than the charge to "enforce the stipulations." Most of the JFWAT monitors had little or no experience in construction projects, and only limited knowledge of related physical processes potentially affecting fish and wildlife resources. There was great inconsistency among monitors in defining problems, in scaling them for significance, and in determining what actions should be taken to resolve them. Moreover, the biologists (as well as other monitors) were often perplexed and frustrated by the lack of clearly defined roles, authorities, and procedures in the field. Lines of communication were often tangled; messages were frequently distorted, delayed, or blocked as they were passed through the circuitous channels from JFWAT monitor to AOFR to central office to Alyeska to execution contractor to construction foreman to laborer.

Recommendations for improving the monitoring process in the future are:

1. Develop field manuals for all monitors. These should include basic information on mitigative techniques such as erosion control; types of soils; selection, uses, and maintenance of material sites; fish passage structures; sampling and testing methods; monitoring procedures; documentation requirements; and background discussions of environmental concerns such as sensitivity of fish to blasting at different life stages, significance of culvert velocity criteria, and sensitivity of nesting, lambing, spawning, and other critical biological habitat.

2. Establish criteria and procedures for reporting violations of project stipulations and follow-up action on such reports.

3. Authorize AOFRs (or their equivalents) to communicate directly and officially with execution contractors in the field to resolve immediate problems that, in the AOFRs' judgment, require such direct action.

4. All field monitoring documents including field logs should include reference to specific stations and alignment sheets for each entry; all field monitors should keep logs; and follow-up actions on reported violations should be fully documented.

Fish and Wildlife Information: Project and environmental information are interrelated elements of a comprehensive data base for a surveillance program. In this case there were serious deficiencies in both kinds of information. It is unrealistic to expect that information will ever be complete for all the purposes it ideally serves in project planning and monitoring. What can be expected, however, is that precon-

struction planning identify the likely range of information needs, determine what is known and what is not known, and establish priorities for filling critical information gaps. The environmental impact statement (EIS) process is the logical place systematically to assess the adequacy of project, environmental, and impact information; to evaluate the benefits and costs of higher levels of information; and to suggest priorities for pre-construction, construction, and post-construction study programs.

Recommendations concerning fish and wildlife information development are:

1. Use the EIS process to plan a comprehensive information development program, including analysis of trade-offs between higher information levels and expedited construction.

2. Within the framework of such a plan, set preconstruction research requirements as appropriate for additional stream surveys, studies of fisheries, characteristics of big game, and habitat surveys of potentially endangered species and of related critical biological areas.

Industry Responsibility: Effective government surveillance depends on how well industry fulfills its reponsibilities for designing a project and monitoring contractor construction work in the field. Industry's incentives to assure the structural integrity of a project are greater, however, than its incentives to assure additional degrees of environmental protection beyond that which follows as a by-product of structural integrity. Thus, government must impose reasonable environmental protection requirements on industry and effectively enforce them. In these matters, there was considerable slippage on both government and industry sides in this case.

Recommendations in the area of industry responsibility for effective design and monitoring are:

1. Initiate project criteria and preliminary design development at the earliest possible time.

2. Government should provide detailed environmental criteria (such as the stream-culvert velocity, big game crossing, and construction window standards used in the pipeline case) to permittees at an early date, and require their inclusion in project criteria and design.

3. Early in the planning phase, establish a complete reference library containing supporting technical and environmental documentation for all design submissions and maintain this documentation throughout construction. Locate this library in the city where the government surveillance organizations are based.

4. The right-of-way agreement or other authorizing instrument should require that fully acceptable quality assurance and quality control programs must be approved before issuance of notices to proceed. In addition to those mandatory criteria listed in section nine of the trans-Alaska pipeline agreement, government should require:

- a quality control organization structurally separate from construction management at every level;
- appropriately trained and adequately staffed environmental and technical quality control components;
- field level authority to stop work, with orders issuable directly to execution contractors;
- establishment of varying but definite times for clearing reports of stipulation violations, including requirements for field checks of actual corrections; and
- periodic government audits of quality control organization and documentation, and notification to AOFRs of all stipulation violations reported and stop-work orders issued.

REFERENCES

1 *Trans-Alaska Pipeline Authorization Act*, Title II of Public Law 93-153, November 16, 1973, section 203(a).

2 Interviews with six AOFRs, one FSO and six JFWAT monitors, Anchorage, August and September 1977.

3 Generalization based on interviews with six AOFRs, one FSO and six JFWAT monitors, Anchorage, August and September 1977.

4 Rockwell, Julius, Jr., and Richard L. Johnson. *List of Streams and Other Water Bodies along the Trans-Alaska Oil Pipeline Route* (draft, 4th revision, 1977). The figure is an estimate.

5 Interviews with six JFWAT field monitors, August and September 1977.

6 Meeting Report from APO wildlife biologist to authorized officer, Subject: "APSC Action re: Big Game Movements," March 22, 1974.

7 Engineering Release 553, Alyeska Pipeline Service Company, August 1975.

8 Memorandum to the files from James E. Hemming, APO/JFWAT, Subject: "Status Report, Big Game Crossing," December 21, 1976.

9 JFWAT Meeting with President's Council on Environmental Quality, Anchorage, May 12, 1977.

10 Interview, telephone, with Morris J. Turner, APO, acting authorized officer, Anchorage, October 21, 1977.

11 "An Audit of Wildlife and Road Crossings, Pipeline Sections 1, 2, 3, 4," Alyeska Pipeline Service Company Quality Assurance, December 1975.

12 Memorandum from JFWAT staff wildlife biologist to JFWAT federal coordinator, Subject: "Remedial Action on B.G. Crossings," September 20, 1976; and Memorandum from JFWAT federal coordinator to files, Subject: "Status Report—Big Game Crossing," December 21, 1976.

13 Memorandum to files from APO authorized officer's representative, Subject: "Project Review Meeting," December 10, 1976; letter from state pipeline coordinator to president, Alyeska, October 28, 1976.

14 The preceding summary of field-level disagreements about work pad excavation was drawn from interviews with six AOFRs and six JFWAT field monitors in Anchorage during August and September 1977, and interviews with James Hemming and Keith Morehouse, JFWAT, Anchorage, August 1977.

15 *List of Designated Wildlife Crossings for the Trans-Alaska Oil Pipeline.* JFWAT Special Report Number 11, August 1977.

16 Interviews with James Hemming, JFWAT APO, and Keith Morehouse, JFWAT, Anchorage, August 1977.

17 Norton, David W., "Effects of Trans-Alaska Oil Pipeline Construction Phase on Fish and Wildlife Management," Paper prepared for Commission Counsel, MacKenzie Valley Pipeline Inquiry, March 24, 1976, p. 16.

18 "Analysis of the Cost of Delay in the Trans-Alaska Oil Pipeline Project," by Michael J. Scott, Appendix D *in* Fish and Wildlife Protection in the Planning and Construction of the Trans-Alaska Oil Pipeline, FWS/OBS-78/70, by Thomas A. Morehouse, Robert A. Childers, and Linda E. Leask, October 1978.

19 See *Alaska Natural Gas Transportation Act of 1976*, Public Law 94-586, October 22, 1976, Section 11. ♦