Agroborealis

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Agricultural and Forestry Experiment Station

School of Agriculture and Land Resources Management

University of Alaska Fairbanks

In SALRM,
We're Looking Forward to the 1990s

In the School of Agriculture and Land Resources Management (SALRM), we're excited about the 1990s for a number of reasons.

This year we expanded our horizons as we initiated an exchange program with the Siberian Branch of the Soviet Academy of Agricultural Sciences, the major agricultural research institution of the Soviet Union. I don't want to repeat what you'll read on page 5, but I'm enthusiastic about this program's potential. Working cooperatively with Soviet scientists, we can meet and solve many of the unique natural resources related problems of arctic and sub-arctic regions. Our joint work will benefit all citizens of circumpolar nations, as well as Alaskans and Soviets. So many areas of joint research are possible for both Soviets and Alaskans to study.

Just look at the diversity of topics already addressed by faculty in the School of Agriculture and Land Resources Management and the Agricultural and Forestry Experiment Station. In this issue of ***Agroborealis*** alone, you'll find articles from our scientists touching on many aspects of northern life—from dog mushing to natural resources public communication; joint planning processes to livestock diets and more.

In all our research, we try to find practical solutions to potential problems before they become problems. Two articles showing this aspect of our work are Dr. William Mitchell's article on recovering oil-damaged lands and Dr. Glenn Juday's report on last year's oil spill. Dr. Mitchell's findings will be invaluable in the event of an oil spill on land. Dr. Juday's previous work in the Prince William Sound area, while not originally designed with an oil spill in mind, provides some valuable information that may be useful in evaluating impacts of the *Exxon Valdez* oil spill. He returned to the area last summer, after the spill, to gather new data.

In the School of Agriculture and Land Resources Management, we include our students in our different studies. Let me call your attention to *History of the Alaskan Reindeer Industry and Its Problems with Land Use, Ownership and Marketing* by Gretchen Kerndt on page 22. Each year SALRM students write dozens of papers on the full gamut of topics in natural resources, forestry, and agriculture. These papers represent considerable effort in both the writing and the research required to meet the standards expected of our students. Beginning with this issue of ***Agroborealis***, we intend to publish one of the best student papers submitted each year. The annual student paper is selected by a faculty committee from papers nominated by individual faculty members. Kerndt is a senior in the School of Agriculture and Land Resources Management majoring in land resources management.

The 1990s are indeed going to be a challenging and fulfilling time, and we're looking forward to our role in the new decade.

James V. Drew

James V. Drew
Dean, School of Agriculture and Land Resources Management
Director, Agiculture and Forestry Experiment Station

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Table of Contents

ABOUT THE COVER ...*Herders near Ulan Ude in the U.S.S.R. weigh the spring lamb crop from the large research herd visited by UAF scientists during the just inaugurated exchange program with SALRM and the Soviet Union's major agriculture research organization.*

AFES Notes

Six SALRM/AFES employees received Meritorious Incentive Awards and $1,200 checks for outstanding work. **Janice Glenn**, **Sue Englerth**, and **Peg Banks** earned the recognition from the staff. Among the faculty, **Bob Weeden** was named the award winner in the teaching classification; **Jay McKendrick** in public service; and **Meriam Karlsson** in research.

Contributors in CES and SALRM doubled their giving to the Tanana Valley United Way Fund Drive over last year. In all, staff and faculty contributed more than $5,600 to the local charity. The two units donated more than 112 percent of their goal. **Anthony "Tony" Gasbarro** headed up the drive in the units.

Graduate student **Randy Rogers**' paper, *An Evaluation of Eligibility for Subsistence Hunting in Wrangell-St. Elias National Park, Alaska*, was accepted for presentation at the Western Social Science Association Annual Conference.

Dr. **Chien-Lu Ping**, Associate Professor of Agronomy, was invited by the Soil Science Institute, Academia Sinica, to visit China from September 20 to October 10, 1989. Dr. Ping visited many Chinese scholars and toured the research facilities in four national soil research institutes and three universities in Nanjing, Xian, Beijing, Harbin, and Shengyang. Dr. Ping presented seminars on his research in the genesis and classification of Andisols and Spodosols, and discussed possible cooperative research projects. Dr. Ping has organized the Alaska Soil-Geography Workshop as a summer course and interim training for the professional soil scientists in Alaska as well as from outside the state. Dr. Franz De Coninck, from Geological Institute, University of Ghent, was invited as a guest lecturer at the workshop. Dr. Ping has been elected the chairman for the 1989-1990 Western Regional Cooperative Soil Conference, and he is busy coordinating the conference to be held in June 1990 in Fairbanks. Currently, Dr. Ping is working with his research associate in characterizing soils from interior Alaska, and in the organic matter and carbon conversion factors in subarctic soils. Dr. Ping also works with soil scientists from USDA Soil Conservation Service on the classification of permafrost soils in Alaska. Dr. Ping has been awarded a two-year contract from Usibelli Coal Mine, Inc., to study the soil-landform relationship in the Hoseanna/Lignite Valley area.

Dr. **Jenifer Huang McBeath** received a grant from the USDA Animal and Plant Health Inspection Service's Plant Protection and Quarantine program to continue her work in plant pest survey and detection. In August, Dr. McBeath attended the Third International Trichoderma Workshop in Ithaca, New York.

Art by **Darlene Masiak**, lab assistant, was featured in an October show **4** *Women Who Never Knew Gertrude Stein '89* at the UAF Fine Arts Gallery.

Dr. **Leslie J. "Buzz" Klebesadel**, professor emeritus, is now a published poet and publisher. Through his own Kilderkin Press, he released *Observations on This 'n' That by OLD AL ASKA, the Sourdough Sage and Bard of the Boondocks*. Copies of the humorous publication are available through Kilderkin Press, P.O. Box 817, Palmer, AK 99645.

The Fairbanks North Star Borough School District presented Dr. **Carla Kirts** with a plaque and commendation for her years of service on the district's Vocational Advisory Committee.

Dr. **Meriam Karlsson** was awarded the Alex Laurie Award by the Ohio Florists' Association. Along with the award, Karlsson received a $1,000 check honoring her as the author of the best research paper published during 1988 in either *HortScience* or the *Journal of American Society for Horticulture Science*. Karlsson wrote the paper, "Quantifying Temperature-controlled Leaf Unfolding Rates in 'Nellie White' Easter Lily" which was published in the January 1988 issue of the *Journal of the American Society for Horticultural Science*.

Graduate student **Jonathan Kamler** had a paper accepted for presentation at the Western Social Science Association program. His paper, based on research as part of his master's program, is *Science Landscape Preferences Along the Dalton Highway, Alaska*.

Sophomore **Tim Hammond** won a $1,200 scholarship and first place honors in an essay contest sponsored by the National Rural Water Association. Hammond wrote on the "Legal Aspects of Water Quality Management." In the paper he chronologically traced legal developments in water quality throughout the United States. He primarily addressed federal legislation and state legislation when state laws provided model legislation.

Dr. **Thomas Gallagher** was awarded a three-year Kellogg National Leadership Fellowship. The fellowship provides $35,000 and 25 percent release time to complete approved study. His study topic concerns how university natural resource programs might better serve Native peoples. As part of his study, he will visit universities in Latin America, New Zealand, Australia, Canada, Scandinavia and the USSR.

Cooperation in Agricultural Science between Siberia and Alaska

Wayne C. Thomas *

Initial Stages: In responding to a U.S. State Department request for proposals in early 1986, the University of Alaska Fairbanks (UAF) Agricultural and Forestry Experiment Station (AFES) initiated a process which led to a major exchange program with the largest and most important agricultural research organization in the Siberian region of the Soviet Union. AFES originally proposed an exchange of germplasm (seeds and plant materials) and information on techniques in agronomy, horticulture, and farm management with research institutions in the Russian Republic specializing in northern agriculture.

Nothing happened for the next two years as far as could be determined at the time. In hindsight, it appears that ideas from the AFES proposal were considered in U.S. and Soviet negotiations on agricultural exchanges. Included in a protocol signed by the two countries was an agreement to exchange methods of conducting agriculture and crop rotation in northern latitudes. When the first Russians' visit occurred under this protocol, their itinerary also included the U.S. Department of Agriculture's (USDA) Agricultural Research Service in Beltsville, Maryland; North Dakota State University; and the University of Minnesota. So while other institutions were involved in establishing this exchange, AFES's proposal, at minimum, helped lay the groundwork.

Another approach started in October 1987 when Dr. Donald O'Dowd, University of Alaska president, received a letter from Dr. Yuri A. Novoselov, vice president of the Lenin All-Union Academy of Agricultural Science, Siberian Branch (VASKhNIL SB), located in Novosibirsk, U.S.S.R. Novoselov asked if the university was interested in cooperation in agricultural science. He invited a university representative to visit VASKhNIL SB for further discussions.

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Beginning in 1988, the two-track approach was under way toward the joint cooperation goal. It would be comforting to indicate that everything moved smoothly from this point, but that was not to be. Several problems developed.

Under the State Department's protocol, a delegation of Russian scientists interested in northern agriculture was to visit the U.S. in July or August 1988. No delegation arrived; however, in August we learned the trip was rescheduled for October 1988. This too was postponed. While this was going on, AFES, through President O'Dowd's, office indicated it wished to accept Novoselov's invitation and visit VASKhNIL SB. Several weeks of trial followed as both parties tried to get telex communication links established (and wondering at times if it was going to happen). Then, things begin to fall into place.

VASKhNIL SB was pleased that the visit was going to occur and the Soviet team under the protocol arrived in November 1988. Senior administrator of VASKhNIL SB, Academician V. I. Kirjushin, and translator Nina V. Pastukhova represented the Soviet Union. In mid-November 1988, Drs. Wayne Thomas, AFES; and Donald Lynch, UAF professor of geography, visited the Soviet Union for AFES. Lynch was selected for his expertise in Soviet geography and fluency in Russian.

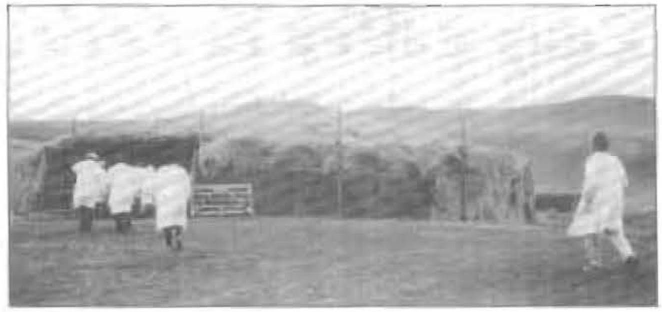
The two-track approach came together very nicely, more by happenstance than good planning, when discussions—started in Fairbanks during Kirjushin's visit—were completed 10 days later in Novosibirsk. Through these two meetings Soviets and Alaskans gained some insight into the research and instructional emphases of the other. VASKhNIL SB and UAF AFES concluded a five-year agreement with 1989 as year one.

Present Accomplishments

The directions taken under the present agreement are not all that different than those proposed in 1986. Four areas were emphasized in the first year of the program.

In germplasm, the purpose of the first summer was to collect and exchange seeds of grasses, cereals, and legumes adapted to high latitude. Four scientists were selected with backgrounds in agronomy and plant genetics. Two AFES scientists, Drs. William Mitchell and Stephen Dofing, were in Siberia for two weeks in August 1989. Their Soviet counterparts, Drs. Nikolay A. Surin and Vasily S. Molofeev, spent two weeks in Alaska in late July and early August. Initial reports from their joint visits indicate that a substantial amount of germplasm from grasses, cereals, and legumes has been exchanged and will be evaluated in the 1990 summer season in both Alaska and Siberia.

Cropping systems include conservation tillage, fertilization, land clearing for agriculture, and cropping system computer modeling. Three Alaskan scientists, Dr. Carol Lewis and Dr. Charles Knight from AFES and Verlan Cochran from the USDA's Agricultural Research Service, spent early June in Siberia. Their counterparts from the Siberian Research Institute of Arable Farming and Use of Agrochemicals, Drs. Anatoly M. Nesterenko, Aleksandr I. Yuzhakov and Ivan N. Sharkov, came to Alaska in late July. Substantial progress was made; research projects were identified, data exchanges organized, and joint publications planned.



At their research facility near Ulan Udi, Soviet scientists and technicians use this hay barn as a maternity ward for their sheep. It provides out-of-the-elements protection for 200 ewes at a time.

The third area selected for study was economic problems of northern agricultural development. The initial objectives were to observe and discuss agricultural development in both Siberia and Alaska. One economist from Siberia, Dr. Y. A. Novoselov, visited Alaska in June and UAF's Thomas visited Siberia in July. Common problems were observed; distance to market and transport difficulties are obvious similarities. It was agreed that both parties would benefit from information gained through the continuation of this joint cooperation.

Musk ox research is included under this agreement. Dr. David Klein of UAF's Alaska Cooperative Wildlife Research Unit is cooperating with the Institute of Extreme North Agricultural Research in Norilsk, U.S.S.R., which is associated with VASKhNIL SB. Klein visited the Norilsk region for three weeks in August 1989. Some of the Soviet musk oxen studied originated from 40 animals captured and transplanted from Nunivak Island, Alaska in 1975. Two Soviet scientists will visit Alaska in 1990 as part of the joint studies planned which will address the many-faceted aspects of musk ox ecology.

UAF Chancellor Patrick J. O'Rourke and Dr. Novoselov exchanged administrative visits last summer. Novoselov represented Petr Goncharov, president of VASKhNIL SB who was ill. Dr. Igor S. Potapiev, chief, division of international cooperation in science and technology of VASKhNIL SB, joined Novoselov in visiting Alaska in early June. O'Rourke and Dr. James V. Drew, AFES director, were in Siberia in early July. On July 12

1989, Goncharov and O'Rourke signed a joint resolution at a reception in the American Embassy in Moscow recognizing the agreement between VASKhNIL SB and UAF and supporting its continuance. This signing was in the presence of Dr. Aleksamgr N. Kashtanov, vice president of VASKhNIL (national office in Moscow), and American Ambassador Jack F. Matlock.

Future Directions

In the future, activities already initiated will continue. Among topics to be added in 1990 and beyond are:

a. Germplasm: exchange plant materials including small fruits and vegetables;
b. Cropping Systems: research in soil microbiology and weed control;
c. Economics: workshop on the agricultural economics of competition and the marketing system;
d. Horticulture and Potatoes: cultural practices and new varieties;
e. Student Exchange: one graduate student from SALRM for three months at VASKhNIL and vice versa;
f. Farmer Exchange: investigation of farming practices and applied research and extension activities; and
g. Reindeer: breeding information and disease prevention (no reindeer work is planned for 1990).

Concluding Remarks

A substantial amount of human resources are being invested into this cooperative agreement.

Is it worth the effort?

There are no certainties, but this exchange has started with good will by both parties. As should be expected, there are different emphases in the sciences in both Siberia and Alaska. Yet each can learn from the other. Farmers and the greater community should also gain from the exchange. It is apparent that East-West relations are improving, and scientists, as well as others, can certainly contribute. An obvious point is to get people together with similar interests and let them trade information, to learn, to disagree, to write papers jointly, will lead to a better society on both sides of the Bering Sea. As artificial boundaries are being removed this a very exciting time to be involved in such an exchange. ❑

International Cooperation in Cropping Systems Research between Alaska and Siberia

Carol E. Lewis *

The cooperative studies overall plan developed by the Agricultural and Forestry Experiment Station (AFES) and the Lenin All-Union Academy of Agricultural Science (VASKhNIL) demonstrates that agricultural scientists in Alaska and Siberia share common goals for adding to scientific knowledge, developing food-production potentials, fostering food security, diversifying and strengthening regional economies, and developing plant materials for food, conservation, and amenity purposes. Two of the soviet scientists, A. I. Kozhevnikov and A. I. Yuzhakov, expressed this commonality in a recent technical paper when they wrote:

> *"As the population on planet Earth continuously grows, the important issue of how to satisfy the requirements for food and vegetative and animal products arises. This problem is especially acute in underpopulated regions of the North, where large-scale development of natural resources such as oil, gas, ores, and timber has begun with concentrated effort. ... [Indeed] while regions of the Soviet North occupy nearly 11.4 million km^2 [equal to 4.4 million square miles or 1 and 1/4 times the entire United States], roughly half of the entire nation's territory, they account for only 0.8 percent of total agricultural production."*

Alaska, accounting for one-sixth of the United States' land mass, produces only five percent of the food consumed by its population, the smallest population of the 50 states (450,000 people in 1988).

The cooperative research plan is very general. Research needs in subarctic areas, on the other hand, are quite specific. Paramount are those topics related to small-grain cropping systems. A working program agreement outlined six points of joint study:

1. Investigate the role of microorganisms in soils on the processes of mineralization and organic materials using soils from Siberia and Alaska. Laboratory studies will be conducted in Siberia and Alaska.
2. Investigate the effect of fertilizer nitrogen (N) sources and placement on barley yields and subsequent economic returns, and within this study, investigate N conversion in crops and soils using ^{15}N.

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3. Develop a joint publication concerning clearing methods specifically and other cropping system research in general, in Siberia and interior Alaska.
4. Conduct modeling studies using data from Alaska concerning climate, soil moisture, and fertilizer amounts.
5. Investigate conservation tillage systems in Siberia and interior Alaska, including shallow and deep tillage, crop residues, and methods of fertilizer placement.
6. Exchange data and computer software which can be used in Siberia and Alaska and investigate related opportunities for exchange.

Item three in the working program is already under way. The AFES scientists provided two publications concerning land clearing in interior Alaska to the VASKhNIL scientists. The Soviet scientists prepared a draft document which was received in September 1989. A joint paper will be prepared in Alaska for publication in international journals. The paper will provide comparisons of land clearing techniques in Siberia and Alaska, pointing out differences and similarities and addressing problems common in both nations.

During the summer of 1990 work will begin on item five using an ongoing study on conservation tillage and management of crop residues in barley production at the AFES Delta Junction research site. Different methods of fertilizer placement and deep tillage techniques will be incorporated in this research design. A similar study will begin in Siberia north of Lake Baykal in Aginsk-Buryat. The area is located at a lower latitude than Delta Junction, but the elevation is higher (4000 feet versus 1000 feet at the AFES research site) thus the climates are similar. The silt loam soils are similar to Delta Junction. This is a critical factor in research concerning conservation tillage and crop management practices.

The overall research agreement and the more definitive working plan represent milestones in agricultural research in the United States. The AFES of the University of Alaska Fairbanks is the first experiment station within the land grant school system to participate in cooperative research with scientists from Siberia.

Most important, however, is the fact that these agreements do not just call for an exchange of research findings. Rather, they are agreements for cooperative, joint research to be conducted simultaneously with United States scientists and their carefully selected counterparts in Siberia. Last July, a visiting Siberian scientist said:

> *"It will be of great interest to talk to your scientists throughout the summer. If we were to receive from you information about what grows best in Alaska, and we were to tell you about what grows best in Siberia, that would be the greatest of success."*

Members of the AFES cropping systems team were Dr. Carol E. Lewis, associate professor of resource management; Dr. Charles W. Knight, assistant professor of agronomy; and Verlan L. Cochran, USDA soil scientist. On the VASKhNIL team were A. Nesterenko, conservation tillage specialist; A. I. Yuzhakov, soil scientist; and A. Sharkov, soil fertility specialist. ❑

Musk Oxen Exchange Offers Researchers New Opportunities

David R. Klein *

During my July 31-August 18 visit to the Soviet Union, I visited Norilsk and the Bikada River Musk Ox Reserve. Basically the visit allowed me to meet Soviet scientists working with musk oxen, as well as those working with other northern animals and vegetation of the north.

From both air and ground observations I gained familiarity with the specific vegetation and habitat characteristics selected and used by musk oxen. This included observing musk ox foraging behavior, plant selectivity, and activity patterns. While in the field we gathered a number of samples including reference samples of plant species not common in the Alaskan tundra. This enables us to make microhistological determinations of plant species in the feces of musk oxen and other herbivores that we collected while in the Soviet Union.

It was of particular interest to me to visit areas near the Norilsk industrial complex and to firsthand assess the damage caused by air pollution. The procedures and findings of specific lichen responses to heavy metals and other pollution will be useful in making comparisons with areas in Alaska and other parts of North America that may be impacted by pollution.

We planned a visit to Alaska by Soviet scientists in 1990. In addition we agreed on collaboration and to immediately begin compilation of existing data from Alaska, Greenland, and the USSR on musk ox ecology. From this and other work, we will jointly author manuscripts for publication in both Russian and English language journals. ❑

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Germplasm Exchange Program

William W. Mitchell * and Steve M. Dofing **

Two Soviet scientists, Professor N.A. Surin and Professor V.S. Molofeev, spent July 20 to August 2, 1989 in Alaska, and we visited Russia from August 6 to 19 spending August 8 to 18 in Siberia. While in Siberia we obtained genetic materials of grasses, legumes, and cereals. These included both varieties or cultivars developed at their Siberian research stations and field collections from native and adventive plant communities. We traveled easterly from Novosibirsk to Nazarovo on our collection trip, covering a linear distance of about 500 miles (800 km) at latitudes of about 55° to 56°N, then returned to Novosibirsk. The trip crossed some of the most productive agricultural land in Siberia.

The region's vegetation consists of woodlands interspersed with open grasslands called woodland steppes. The woodlands are dominated by birch, poplar, and at higher elevations, pines and spruce. Some of the natural grasslands are grazed and hayed but most are cultivated to grow forage and vegetable crops on the large state and collective farms. The villagers use some of the grasslands, mainly along the fringes of fields and woodlands, to maintain their own livestock. There appears to be very little grassland that is not subject to use.

The heavy use experienced by these grasslands adds another dimension to the potential of the grasses occurring there. Native grasses that frequent this area of Siberia include orchardgrass, meadow fescue, timothy, smooth bromegrass, Kentucky bluegrass, tufted hairgrass, quackgrass, redtop bentgrass, reed canarygrass, and tall fescue. Most of these are not native to Alaska. The occurrence of such species as orchardgrass, meadow fescue, and redtop bentgrass attests to a warmer, longer growing season than we experience in southcentral or interior Alaska. Trials with varieties of these three species have shown them insufficiently winterhardy for Alaskan use. However, genetic materials that have developed under the Siberian conditions may be ecotypically different and capable of enduring Alaskan conditions.

Some species collected there are of particular interest. Manchar is the bromegrass variety most commonly used in Alaska today. Although developed at Washington State University, its origin traces to Manchuria, China. Manchuria is south of the Siberian area we visited, thus the Siberian material may be hardier stock. Reed canarygrass has shown high productive potential in Alaska, but it is not used because of the marginal hardiness of the Minnesota-derived material now commercially available. The more northern origin for the Siberian material provokes interest. Also, the grazing experience endured by the native Kentucky bluegrass populations in Siberia encourages speculation on their potential.

Spring barley is one of the most important grain crops grown in the area we visited. Yields appeared to be high, despite lower than average seasonal rainfall. Approximately half of the barley entries we observed in field trials were two-row types. The occurrence of late-spring frosts creates a need for cultivars with a high level of cold tolerance. A few of the widely-grown barley cultivars are actually facultative types; these exhibit a spring-growth pattern when planted in the spring and a winter-type growth pattern when planted in the fall. Resistance to drought and lodging appeared to be the most important breeding objectives. Of particular interest to Alaskan barley production is the cultivar Kedr, which was purported to possess a synchronous-tillering characteristic. If present, this trait could reduce or eliminate late-maturing tillers which delay harvest and reduce grain quality in short-season environments such as Alaska.

Spring wheat is also extensively grown in this area. The longer growing season and warmer temperatures compared to Alaska allowed production of high-yielding, medium-maturity cultivars. No effort was in place to develop winter wheat for this area, as the high level of winter stress would make its production unreliable. However, this area would appear to offer an excellent source of germplasm for winter rye development.

Many of the perennial and annual forage legumes grown in Alaska are also found in Siberia. A strong research effort is devoted to the development of alfalfa strains resulting from the hybridization of conventional purple-flowered alfalfa with the yellow-flowered falcata or Siberian alfalfa. Cultivars have been developed which appear to be productive and possess a high level of winterhardiness.

The varieties and field collections of grasses obtained from Siberia will be placed in trial along with varieties currently in use in Alaska and known to be adapted to Alaska conditions. A comparison of the performance of these two sets of grasses should give us some indication of the potential of this Siberian region to generate materials suited to Alaska. ❑

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A Preliminary Look at Effects of the *Exxon Valdez* Oil Spill on Green Island Research Natural Area

Glenn P. Juday * and Nora R. Foster **

In the early morning hours of March 24, 1989, the supertanker *Exxon Valdez*, full-loaded with more than 50 million gallons of crude oil, set a course outside the tanker lanes of Prince William Sound to avoid some ice in the water. After clearing some scattered, small icebergs the ship should have moved back into the southbound lane. It didn't.

The ship's crew, realizing their navigation error, attempted a last-minute course correction. But the enormous momentum of the tanker's full load carried it directly onto Bligh Reef, a shallow submerged shelf of hard rock. A huge gash ripped the tanker's hull, releasing nearly 11 million gallons of oil. For two days following the spill the *Exxon Valdez* and smaller tankers that were unloading the remaining cargo lay in a localized sludge of thick black crude oil. Slowly, the oil containment and cleanup effort began amidst unusually calm weather. But on March 27 a strong high pressure center moved across the arc of the Chugach Mountains that shelters maritime Prince William Sound from interior Alaska. Strong northeasterly winds pushed down from the mountains on to the water's surface and started the oil on a wild, wind-whipped ride west across the sound under bright sunny skies.

The pristine island beaches of western and southwestern Prince William Sound stood in the path of the oil. Within two days they had received a very large dose of relatively unweathered crude oil. One of the islands on the southern edge of the massive oil slick was Green Island (fig. 1), where, in 1986, we had done some initial work in a long-term monitoring project along the beaches and in the intertidal zone. We did not originally intend to study an oil spill, but now that one has occurred we hope to learn as much as possible about changes in our area. What was the area like before the spill? Where did the oil arrive? What organisms did the oil affect?

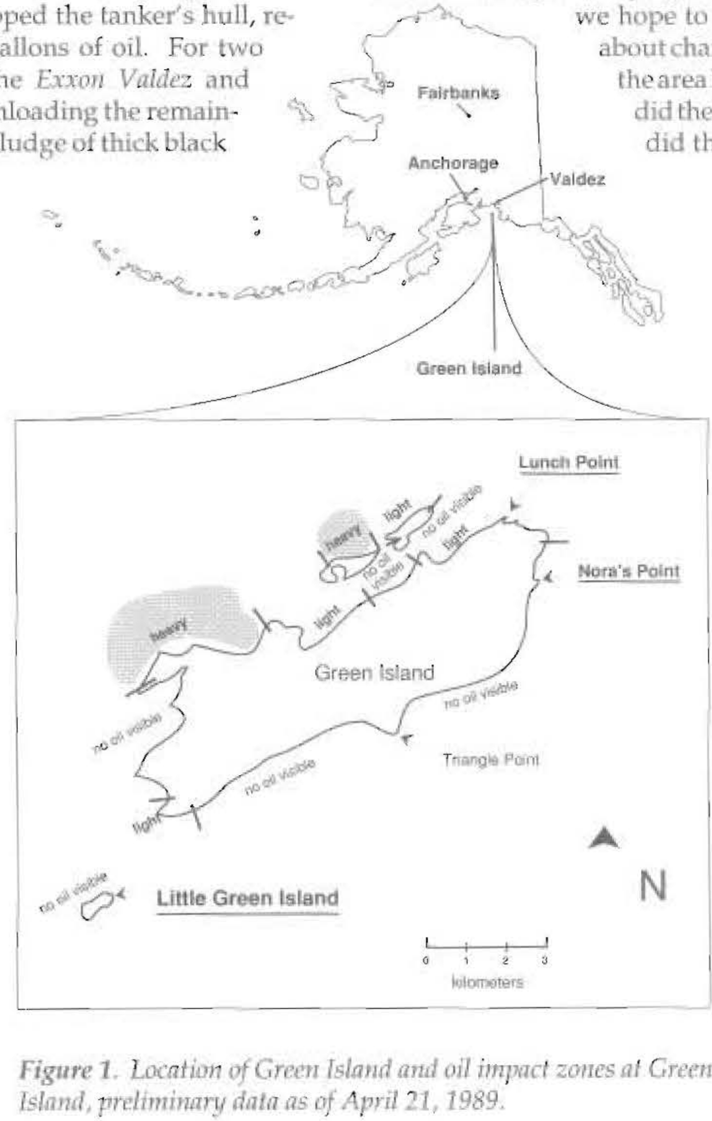

Figure 1. Location of Green Island and oil impact zones at Green Island, preliminary data as of April 21, 1989.

The Study Area

The southeast half of Green Island and all of Little Green Island were proposed in 1981 as one of nine Research Natural Areas (RNA) in the Chugach National Forest (USDA Forest Service 1984). The nine RNA's were selected to include examples of plant communities, plant species, geological features, and animals that are either uncommon or characteristic of the Chugach National Forest (Juday, USDA Forest Service 1983). In this way all the elements of natural diversity in the forest are available for research, monitoring, and conservation. Because the living resources of the land and water

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along the shore are closely linked, we decided to document intertidal environments as well as terrestrial features at Green Island RNA.

There are relatively few ecological and systematic studies on the littoral (shore and shallow water) zone in Prince William Sound (for a review see Hood and Zimmerman 1987). Two studies provide a basic description of the abundance and distribution of intertidal plants and animals in our study area. In 1965 a team visited 33 stations in the sound, including the northeast end of Green Island, to investigate the effects of the 1964 great Alaska earthquake (Haven 1971). The Outer Continental Shelf Environmental Assessment Program sponsored baseline studies of two locations, McLeod Harbor and Zaikof Bay on Montague Island (O'Clair et al. 1978). These are similar to Green Island. Zimmerman and Merrell (1976) describe the abundance and distribution of organisms on the rocky shores of both locations.

In 1986 we visited the Green Island RNA to gather data for an Establishment Record and to document the island's initial condition for future monitoring. The goals of our intertidal reconnaissance were to:

1. *Obtain a species list from the rocky intertidal zone adjacent to beach and forest study plots;*
2. *Identify and define intertidal zonation; and*
3. *Note any unusual animals or assemblages of plants and animals and note any new distribution records or rare species.*

We visited three beaches for three to four hours each during the minus tide series of July 20-22, 1986. We took extensive notes on intertidal zonation, plant and animal taxa, and collected voucher specimens of intertidal and beach organisms for later identification. We lacked the time and funding to establish intertidal transects or permanently mark our study plots. Our notes, however, are accurate enough that our sampling localities can be revisited.

We identified 96 animals (invertebrates and fishes) and 39 plants (algae and seagrasses) in the field or from collections. Our observations included three species previously unrecorded in Prince William Sound (Foster 1987). Figure 2 shows an idealization of the zonation in the rocky intertidal areas of Green Island RNA based on our field work. Intertidal zones can be identified by either the dominant organisms or by height in relation to tidal level. Absolute height above or below tidal datum is given in meters. South coastal Alaska experiences a semidiurnal tidal cycle; two unequal high and two unequal low tides occur daily. We use the abbreviations MHHW for mean higher high water, MLLW for mean lower low water, MLHW for mean lower high water, and MHLW for mean higher low water.

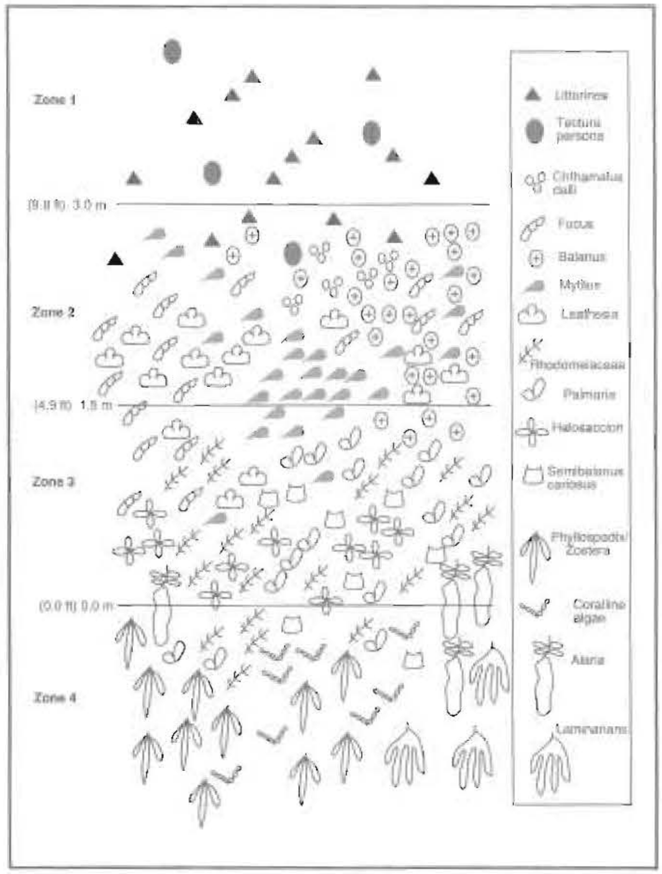

***Figure 2.** Zonation of intertidal plants and animals at Green Island.*

The uppermost zone on the shore of Green Island RNA, about three meters above MLLW, has a black appearance caused by the lichen *Verrucaria*. Animal inhabitants of this zone include the littorinid snails *Littorina sitkana* and *L. scutulata*, and the limpet *Tectura persona*. Zone 2 (generally from +3.0 m to +1.5 m) is dominated by a band of either barnacles, including *Balanus glandula*, *Semibalanus balanoides*, and *Chthamalus dalli*, or by *Fucus gardneri* and *Mytilus edulis*. In Zone 3 (from +1.5 m to 0.0 m) the dominant species are several brown algae including *Fucus*, *Leathesia difformis*, and several species of *Alaria*, and the red algae *Palmaria* spp. and *Halosaccion glandiforme*. Zone 4 (below 0.0 m) is characterized by Laminarians (kelps) and seagrasses.

Methods - 1989 Visit to Green Island RNA

Alaska Department of Environmental Conservation gave us a map which designated the amount of oil that had arrived at Green Island (fig. 1). The estimates were from surveys made within weeks of the spill. We planned to revisit as many as possible of the locations where we had made observations and collections in 1986.

The goals of our 1989 study were to:

1. *Look for evidence of oil on the beaches of the RNA;*
2. *Look for evidence of visible damage to plants and animals of the intertidal zone;*
3. *Establish permanent intertidal transects and beach vegetation transects for long-term monitoring; and*
4. *Note and document any transfer of oil from the water to beaches or uplands.*

When we arrived on August 12, we conducted a reconnaissance to verify the presence of oil (we found it on all beaches) and to observe oil impact. We walked along about four km of shoreline on the north and northeast portions of Green Island. We selected three study locations, Lunch Point, Nora's Point, and Little Green Island (fig. 1). The last two were localities that we had studied in 1986. No oil spill clean up activity took place near Little Green Island and Nora's Point. At the time of our site visit clean up work had been completed west of Lunch Point, but there were no obvious indications that our plots had been directly affected.

At each site we established horizontal beach transects to map the extent and distribution of oil. Mapping extended from about MHHW (or three meters above tidal datum) inland to the line of alder shrubs which delineates the margin of the beach and the islands' wooded interior. The shoreline had a nearly continuous line of oil or tar. Patches of oil along the beach larger than 30 cm along either axis were mapped in their entirety. The extent of oil coverage along the beach was mapped as 1-10% (low), 10-50% (medium), and >50% (high). We chose unequal class boundaries because the presence of a small amount of oil appeared to be associated with a significant amount of change, and amounts greater than 50% were associated with relatively little additional effect at the scale we were mapping in our area.

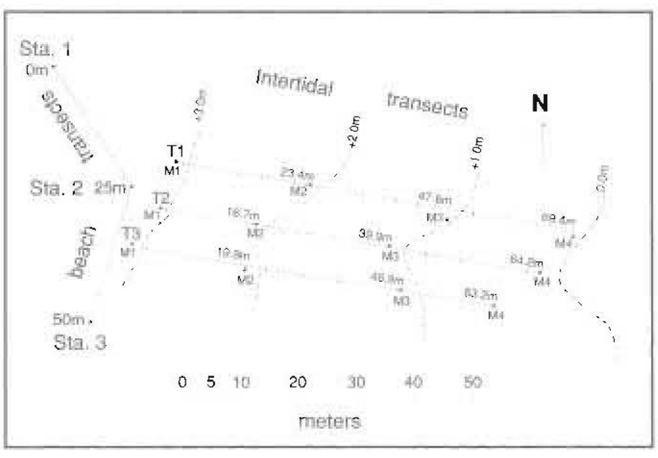

Figure 3. Horizontal beach transect and vertical intertidal transects at Little Green Island. Intertidal transects are labeled as T1, T2, and T3. Intertidal plots (0.5 m x 0.5 m) along each transect are labeled M1 - M4. Dashed lines indicate contours at 1 m intervals above tidal datum. Horizontal distances between plots are indicated.

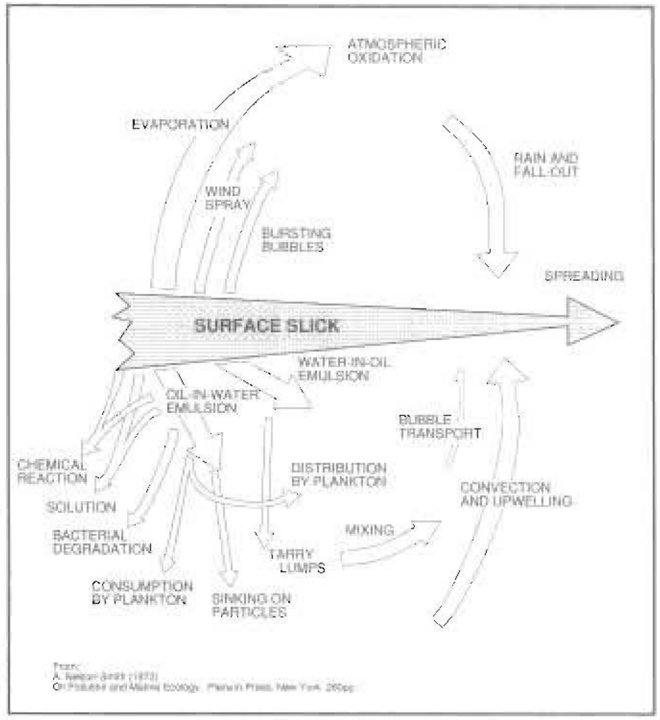

Figure 4. Fate of crude oil in the marine environment.

In the intertidal zone, we established three parallel transects oriented perpendicular to the shoreline. Along each transect line we established plots of 0.5 m x 0.5 m at vertical intervals of 1.0 m to determine the condition of marine organisms and communities (fig. 3). We photographed each intertidal plot, took notes and made collections of the plants and animals present, while noting the oiling condition. We made cover and abundance measurements from 8" x 10" black and white prints of the photos. Both the horizontal and vertical transects were permanently marked.

Results and Discussion

Oil: Figure 4 shows the natural physical and chemical processes that disperse and degrade spilled oil. Volatile components evaporate and are oxidized in the atmosphere. Emulsions—mixtures of oil in water or water in oil—may partially dissolve, react in seawater or sediments, be consumed by plankton or benthic organisms, or degrade by bacterial action. Insoluble particles and tar balls sink, and then become subject to chemical or bacterial degradation in the sediments (Nelson-Smith 1973).

Spilled oil is certainly most visible and perhaps most damaging when it washes ashore. Most studies of marine oil spills have been carried out in the intertidal zone (Sandborn 1977). Oil on rocky shores affects populations of susceptible organisms. Loss of key organisms affects, in turn, the structure of the intertidal community.

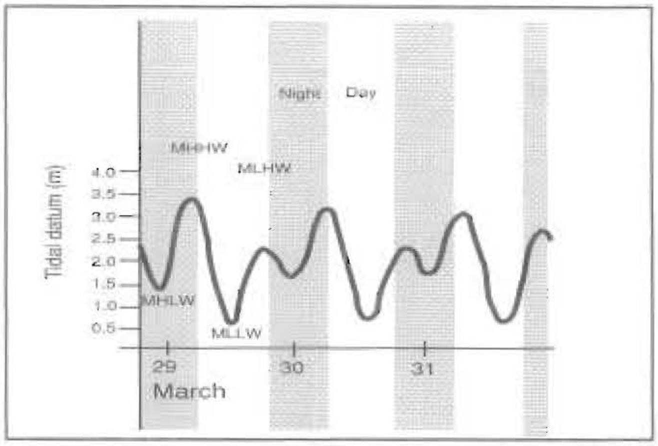

Figure 5. Tide range near Green Island, March 29 through March 31, 1989. (Adapted from Applegate Island station) *© 1989 Zihua*

Oil and oil mousse have obvious mechanical effects; they clog surfaces and suffocate animals. Also, the added weight of oil may cause sessile (attached) animals and attached plants to be torn off by wave action. Volatile fractions of oil are the most toxic. Volatile compounds kill individual animals and plants, damage living tissues, disrupt enzyme systems, and dissolve or penetrate cell membranes (Nelson-Smith 1973).

Oil and tar that have not picked up heavy debris float on the surface of water. As a result, the height of the tides in late March and early April determined where on the beaches and in the intertidal zone of Green Island the oil came into contact with living organisms. Figure 5 shows the tidal cycle at an area representative of Green Island for a three-day period starting March 29, the day oil arrived at Green Island. Figure 6 is our tentative interpretation of the relative effect of the oil at Green Island at different tidal heights. Our interpretation is fundamentally based on the duration the unweathered oil was in contact with organisms.

In the rating system we developed for this study, we assigned the highest relative effect to the zone from MLHW to MHHW. Any oil coming into contact with the shore on this tide would have been deposited and stranded at the upper range. It could not be refloated and removed by subsequent tides in the declining series of late March and early April at Green Island. We also infer that during the slow change of the tides fresh oil would have remained in contact with plants and animals near the height of the high and low tide stages. Oil also would have been temporarily stranded during declining tidal stages until the next MHHW stage refloated it. The least affected segments of the intertidal zone were within tidal heights that were coated with oil for a brief time between high and low tides and then washed clean as the tides rapidly continued to rise.

Our depiction suggests that oil effects should be most intense at Green Island in the tidal height range of +2.0 to +3.4 m, with a secondary impact zone from +0.5 to +1.5 m. The higher range corresponds to the the Zone 1 and the upper part of Zone 2, dominated by Fucus, barnacles, and Mytilus. According to our depiction, the lower most zone of vascular plants on the beach, above the upper intertidal zone, should also be affected by oil.

Figure 7 shows a 25 m segment of the beach at Lunch Point. The entire RNA shoreline was marked with a stranded oil or tar line. In several cases in our study area oil coated the base of vascular plants. The main oil or tar line generally corresponds to tidal height of the maximum MHHW stage of +3.4 m of the March 29 tides or a slightly greater height. We infer that wave and wind action caused the oil to surge up the beach during the days following the spill, where it was stranded. Short segments of high energy beach were clear of oil and tar in August, either because deposition was low or subsequent wave action removed the oil. Wave acceleration zones or additive wave zones create high energy beaches. Much of the oil and tar was embedded in a matrix of Fucus or surfgrasses. Figure 8 shows the percentage of our three beach study sites not oiled and the percentage rated in the medium category. As indicated by these percentage numbers, we rate the severity of oiling in increasing order as Little Green Island, Nora's Point, and Lunch Point.

Organisms: Figure 9 shows the total cover of plants and animals on intertidal plots at the second vertical level, labeled as station M2, on the transects. These plots are in the middle of Zone 2 (fig. 2), ranging in actual tidal height from +1.75 m to +2.3 m, which is within the tidal range that we infer experienced the greatest impact of oil. Total cover is lowest at Lunch Point. This is consistent with our beach oil data that indicate it was the most heavily oiled site. We believe that the reduction in cover of organisms was real (not due to sampling error) and

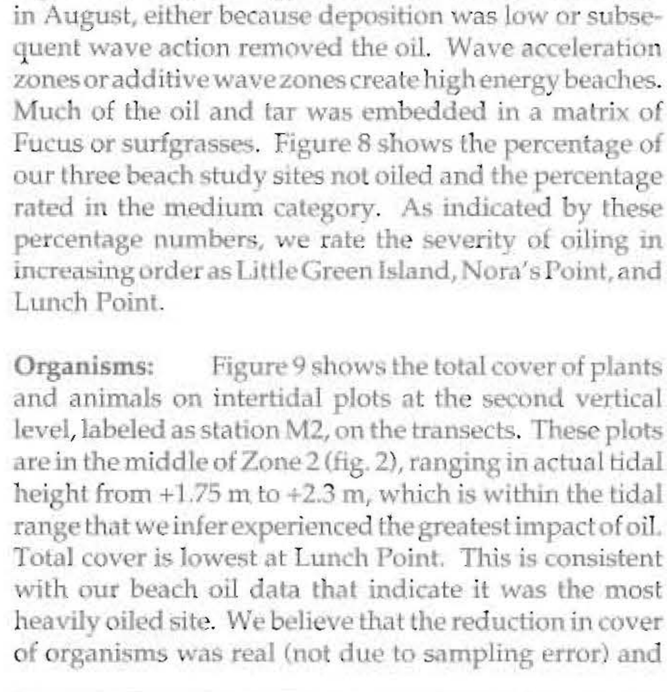

Figure 6. Oil impact at Green Island immediately following the Exxon Valdez spill. Each tidal cycle represents a complete sequence of two unequal high and two unequal low tides which occurred over a 24.6 to 26 hour period on the dates depicted here.

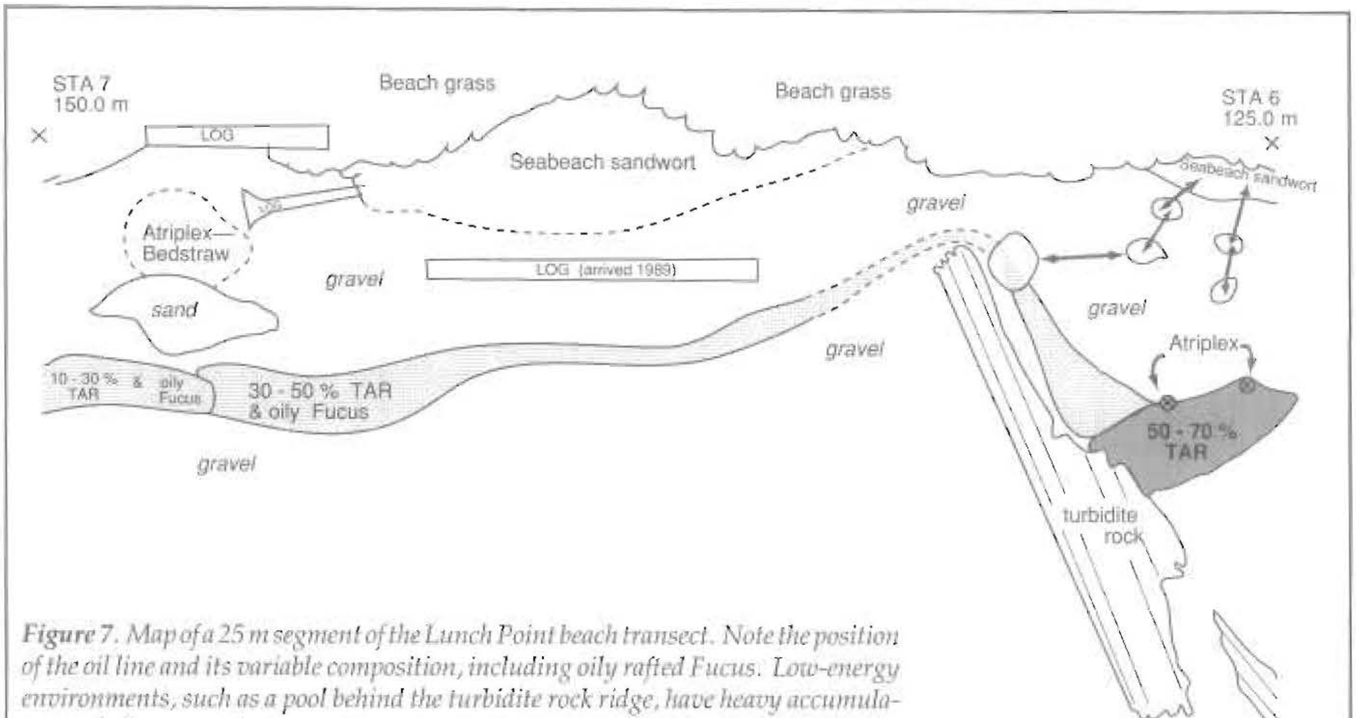

Figure 7. *Map of a 25 m segment of the Lunch Point beach transect. Note the position of the oil line and its variable composition, including oily rafted Fucus. Low-energy environments, such as a pool behind the turbidite rock ridge, have heavy accumulations of oil or tar. The bases of some beach plants are covered in oil.*

was an effect of the oil (fig. 9).

We identified 68 animals and plants during our August survey. In comparing the 1986 and 1989 collections, we note that 37 animals and 6 plants collected or observed in 1986 are not on our 1989 species list. The comparison provides a first list of potentially oil-susceptible or oil-affected organisms for our planned future research. However, we suspect that part of the difference in apparent species richness is due to a greater taxonomic search effort in 1986, and part of the difference is due to the high rate of natural change typical of intertidal communities. We also identified 14 animals and two algae in 1989 that were not on our 1986 species list. We believe that our discovery of "new" species is largely explained by high natural rates of change between the sampling dates, and a certain number of species that were present but overlooked in 1986.

Figure 10 illustrates in quantitative terms the abundance and zonation of dominant plants and animals in the intertidal zone at our three stations. The

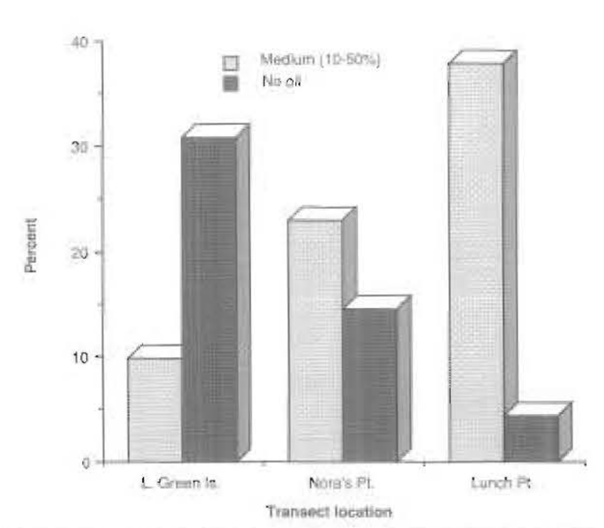

Figure 8. *Beach segments affected by oil at Green Island Research Natural Area. Oil pollution increases left to right.*

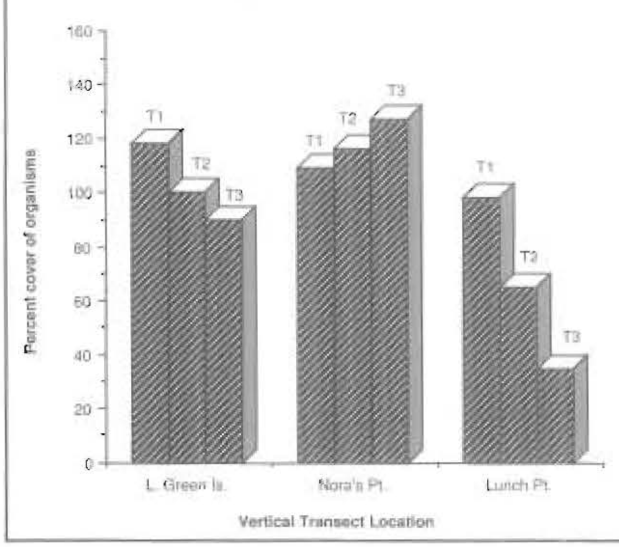

Figure 9. *Total cover of organisms, vertical transect station M2. Note decrease at Lunch Point.*

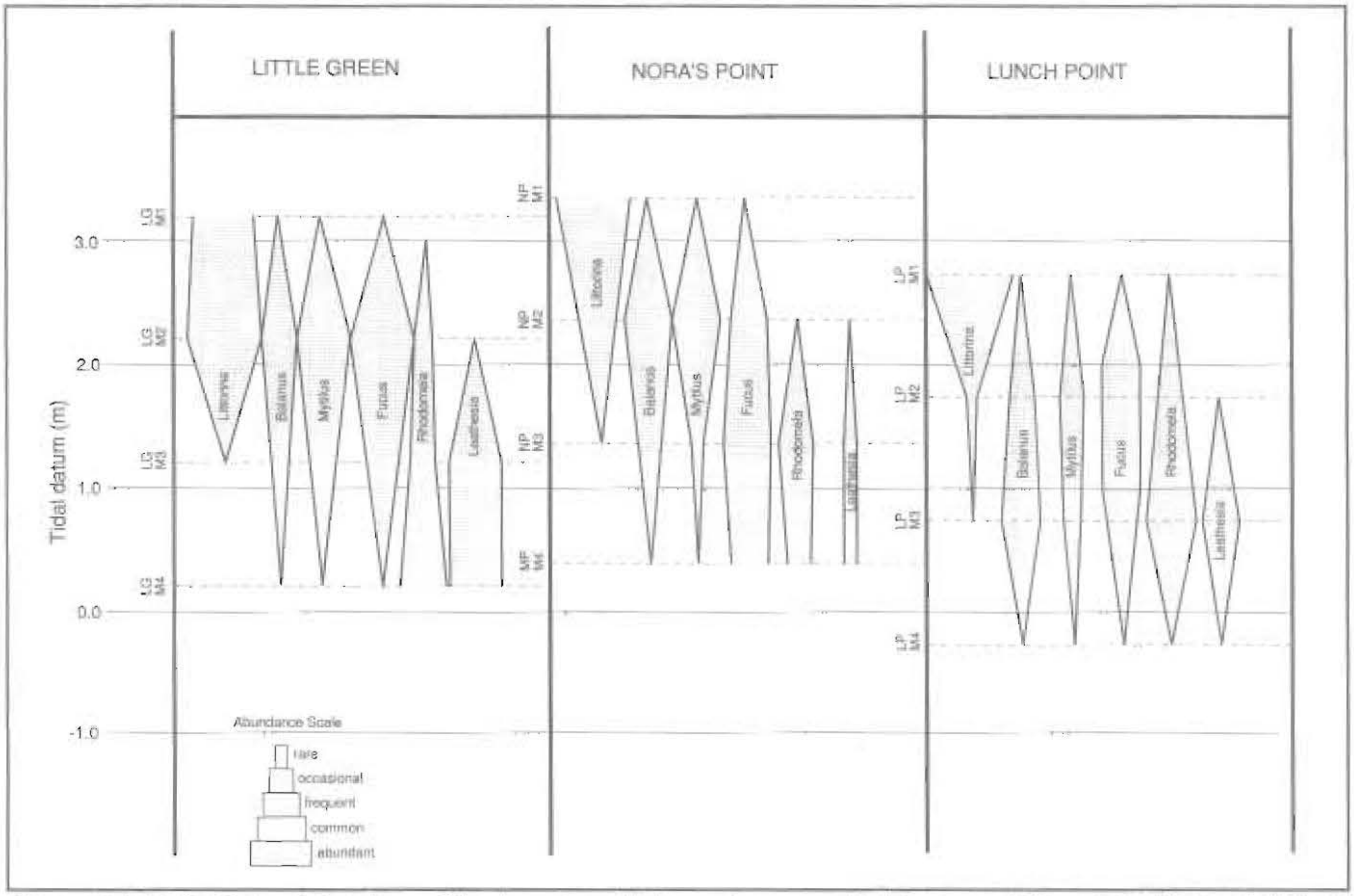

Figure 10. Distribution and abundance of dominant intertidal organisms on vertical transects at Green Island Research Natural Area. Species diagrams become thinner (species less abundant) with increasing oil pollution (left to right).

abundance scale is based on our measurements of percent cover using classes defined by Crisp and Southward (1958) and reported in Monk and Cowell (1977) and Crapp (1970). Such diagrams have been used to indicate the loss of cover by intertidal organisms after an oil spill (Nelson-Smith 1975). The species diagrams in figure 10 become thinner in the same order as our measurements of the amount of oil and tar on beaches increase, Little Green Island (low), Nora's Point (medium), Lunch Point (high). We believe this is a real effect due to oil pollution.

Two animals we observed in large numbers in 1989 but not in 1986 are of some interest. The seastars *Pisaster ochracea* and *Evasterias troschelli* were not seen in 1986. *Pisaster* is one of the most important predators in the intertidal zone along the Pacific coast, and therefore has an influence on intertidal community structure. Ricketts et al. (1985) note that "anything that can damage this thoroughly tough animal, short of the 'acts of God' referred to in insurance policies deserves respectful mention." Figure 11 shows a deeply ulcerated *Pisaster* typical of the more heavily oiled beaches in our area. Some of these seastars were so ulcerated from above and below that holes nearly penetrated their bodies. Although this type of injury would be consistent with oil pollution (Nelson-Smith 1973), we are not yet certain of the cause of the injury in our study area.

Figure 12 shows an intertidal plot at Lunch Point, located in the zone most heavily impacted by oil. Barnacles here are covered with a greasy coating of oil residue. An oil film covers part of the bare rock surface. Many Fucus plants lack fronds ("leaves") and survive as stalks only.

Observations we can make about possible oil effects on organisms in our intertidal plots include the following:

1. Oily *Semibalanus cariosus* experienced mortality at all three stations, but especially Lunch Point and Nora's Point.
2. Surviving Fucus at Lunch Point were oiled and in particularly poor condition, as were *Balanus glandula* and *Semibalanus balanoides*.
3. Coralline red algae along heavily-oiled beaches, such as Lunch Point, were dead and bleached white.
4. Many *Halosaccion glandiforme* and *Palmaria* spp., discolored by loss of pigmentation, appeared to be in generally poor condition.
5. Blades of seagrasses, especially those below oiled beaches, were dead and bleached white.

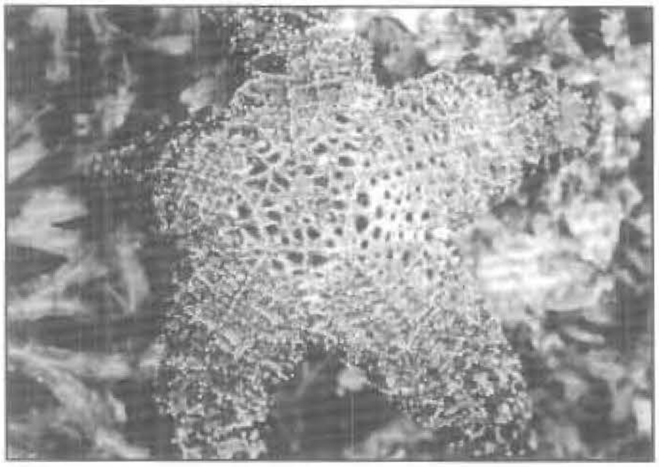

Figure 11. Close-up of an ulcerated Pisaster (purple seastar) from Nora's Point intertidal horizontal survey area, August 18, 1989. The holes at the top center of this seastar are not a normal condition.

Figure 12. Lunch Point intertidal transect T2 plot M2, August 19, 1989. This plot is located in the zone most heavily impacted by oil. Barnacles here are covered with a greasy coating of oil residue and an oil film covers part of the bare rock surface. Note the Fucus plants (fan-shaped algae bent to the right) that lack a frond ("leaf") and survive as stalks only. About one third of the plot on the right supports a bloom of filamentous green algae (visible as a filmy mat surface).

6. Laminarians (*Hedophyllum sessile*, *Costaria costata*, and *Laminaria* spp.) appeared far less abundant in 1989 than in 1986. We observed Laminarian stems and holdfasts that were missing fronds in the lowest zones we surveyed.

One must be cautious in ascribing unusual conditions on the beaches or in the intertidal zone of Prince William Sound in 1989 to the *Exxon Valdez* oil spill. The intertidal environment is dynamic and susceptible to both natural and human-caused disturbances. For example, extreme cold during a series of minus tides has been known to produce damage similar to an oil spill (Nelson-Smith 1975); the Alaska cold snap of January 1989 may be partly responsible for the mortality of Semibalanus cariosus in our area. The 1969 Santa Barbara oil spill in California damaged intertidal seagrasses (Zeiman et al. 1984, Nicholson and Climberg 1971), but seagrasses and red algae usually become somewhat discolored late in the season. Responses of barnacles and mussels to oil spills have been variable, with both survival and mortality reported (see Nelson-Smith 1973 for summary).

A Direction for the Future

The response of public policy to the *Exxon Valdez* oil spill has been largely based on the immediate impacts of the oil spill. Scientific research on the spill has been hampered or largely ignored (Alaska Oil Spill Commission 1990). For example, in the year following the spill, public funds expended from the Comprehensive Environmental Response, Cleanup, and Liability Act (CERCLA) were strictly limited to damage assessment, which was narrowly defined to mean a simple count of damaged

INTERTIDAL ORGANISMS
(in order of decreasing elevation)

Scientific Name	Common Name	Phylum
Littorina spp. or Littorines	sea periwinkle	mollusk
Tectura persona	mask limpet	mollusk
Fucus spp.	rockweed	brown algae
Chthamalus dalli	acorn barnacles	crustaceans
Balanus spp.	acorn barnacles	crustaceans
Semibalanus spp.	acorn barnacles	crustaceans
Mytilus edulis	blue mussel	mollusk
Leathesia spp.		brown algae
Rhodomela spp		red algae
Palmaria spp		red algae
Halosaccion spp.		red algae
Corallinaceae	corraline red algae	red algae
Alaria spp.	kelp	brown algae
Laminaria spp.	kelp	brown algae
Phyllospadix serrulatus	surfgrass	vascular plant
Zostera marina	eelgrass	vascular plant

SHORELINE PLANTS

Heracleum lanatum	Cow parsnip	vascular plant
Elymus arenarius	Beach grass	vascular plant
Lathyrus maritimus	Beach pea	vascular plant
Galium aparine	Bedstraw	vascular plant
Atriplex gmelini	Atriplex	vascular plant
Honckenya peploides	Seabeach sandwort	vascular plant

***Table 1.** List of scientific and common names for common organisms at Green Island Research Natural Area.*

resources that can easily be measured in dollars (Trustee Council 1989) Nearly all scientific research using CERCLA funding has been ruled out because it does not meet these criteria If the plaintiffs and defendents choose to settle out of court, all CERCLA funding for investigations would cease immediately. The state of Alaska's special legislative appropriation for oil spill response measures can be released only for those projects whose costs are recoverable from litigation.

Given the high rate and many sources of change in intertidal environments, we feel that it is crucial to monitor key variables over the long term if damaging events such as the *Exxon Valdez* spill are to be fully understood. Principles for designing such scientific monitoring programs are available and need to be followed (Green 1979). We believe that, although not originally designed as an impact study, the monitoring Green Island RNA has already shown its value. ❑

Acknowledgements

The authors acknowledge the assistance of Michael Carroll in developing the intertidal transect study design and in collecting data from intertidal plots. Robert Solomon, Robert Cullum, and Peter Poudel assisted in field work and logistic support. Jim and Nancy Lethcoe generously shared their valuable knowledge and insight about the local environment. This study was supported by the the University of Alaska Fairbanks and by the USDA Forest Service PNW Research Station and Alaska Region, Grant Agreement PNW 86-491, Amendment 5.

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Land Farming of Oil Sludge at Valdez Oil Terminal

William W. Mitchell * and G. Allen Mitchell **

Tankers returning to the Valdez oil terminal are loaded with ballast water for purposes of stability. As the tankers cannot be completely emptied of their oily cargo, this water contains Prudhoe Bay crude oil that must be removed in a treatment facility before the water can be allowed to enter the bay. A semisolid oil sludge results as a waste product of this treatment. Eventually, this material must be disposed of, and to explore the possibility of accomplishing this by a local means, Alyeska Pipeline Service Co. sponsored research on "land farming" the oil sludge. This means of disposal would involve incorporating the oil sludge into soil prior to planting.

Though oil may have long term effects on soil and vegetation (Sparrow and Sparrow, 1989), previous research conducted at Palmer, Alaska, on soil contaminated with Prudhoe Bay crude oil showed the benefits of both fertilization and tillage in promoting oil degradation and the establishment of plants (Loynachan 1978; Mitchell et al., 1979). The latter study provided evidence that part of the detrimental influence of weathered oil in the soil is due to its hydrophobic nature, thus producing droughtiness. It also suggested a threshold level of tolerance for oil contamination with germination and plant growth occurring below about 7.5 percent oil content.

Figure 1. Oil sludge deposited on the topsoil prior to mixing it with the soil that has been spread over the surface of the gravelly substrate.

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Procedures

The research at the Valdez oil terminal was conducted in a diked area on a rocky and gravelly substrate over a polyethylene liner. Topsoil obtained from the Glennallen area was spread over the surface of this substrate, forming about a six-inch layer. The oil sludge was deposited on the surface and worked into the topsoil with a bulldozer (Figures 1 and 2). Because of the inexact nature of this mixing process, the content of oil sludge in the soil throughout the trial area was not uniform, which provided for some interesting results. The oil sludge was strongly acidic (pH 4.7), which prompted the application of the following three lime treatments to the 40 x 90-foot trial area:

a) no lime applied (no-lime treatment);
b) lime applied at three tons/acre and raked into the surface (surface-lime treatment); and
c) lime applied at three tons/acre and mixed with soil by rototilling (tilled-in lime treatment).

The entire trial area was fertilized with 18-18-18 at 560 lb/acre, supplying 100 lbs/acre each of nitrogen (N), phosphate (P_2O_5), and potash (K_2O). On July 1, 1986, 11 perennial grasses and three annuals were seeded in furrows eight feet long in three replications in each of the three lime treatments. Live propagules of beach wildrye and water sedge also were planted in each treatment on

Figure 2. A bulldozer worked and reworked the oil sludge and topsoil to produce the oil sludge/soil mix.

July 1. At the end of the first growing season, three perennial grasses were seeded between the rows of the annuals. These remained dormant over the winter and germinated the following spring. On July 18 of the following year the entire trial area was fertilized with 16-16-16 at 750 lbs/acre supplying 120 lbs/acre each of nitrogen, phosphate, and potash.

Results

Differences in performance related to lime treatment were evident at the end of the first growing season. The no-lime treatment produced the poorest growth. Growth was generally better on the surface-lime treatment than on the tilled-in lime treatment. These results are reflected in the analysis of percentage ground cover of the annuals (Table 1). The perennial grasses, in general, grew one to two inches tall and displayed obvious signs of stress. Some occasional tufts appeared healthy and grew much taller.

The plantings were examined twice in the succeeding year (1987)—on July 18 when the fertilizer treatment was applied, and on October 3 when the trial was given its final evaluation. On July 18, the three perennial grasses seeded in the previous fall were in the advanced seedling stage and showed better establishment and a healthier growth than the summer seedings had in the previous year. This was interpreted as indicating the beneficial effects of weathering on the oil sludge. Most of the growth of the surviving perennial grasses seeded in 1986 occurred in replications I and II of the treatments receiving lime. Only fragmentary growth occurred in the no-lime treatment.

On October 3, the surviving grasses manifested a striking improvement in growth. As in the previous year, the surface-lime treatment supported better growth than the tilled-in lime treatment (Table 2). The no-lime treatment essentially was a failure. The fall seedings were well established on all three replications of the surface treatment and in the first two replications of the tilled-in treatment. They virtually failed on the no-lime treatment.

The various grasses differed in their apparent tolerance of the sludge/soil mix (Figure 3). Norcoast Bering hairgrass, Arctared red fescue, alkaligrass, Nugget Kentucky bluegrass, and Nortran tufted hairgrass achieved the most growth (Table 2). Norcoast was particularly successful in the fall seeding. The live-propagule transplants of beach wildrye and water sedge survived in all treatments, including the no-lime treatment.

Analyses of soil samples taken on July 18 and October 3 indicated the process of weathering was producing a decline in oil content (Table 3). The decline averaged 12 percent over the three treatments during

***Figure 3**. Two of the replications of the surface-lime treatment are represented in the foreground with the no-lime treatment visible in the background. The grass entries evinced different tolerances to the oil sludge mix. Some of the better performers visible in this photo are alkaligrass in the very bottom right foreground, Norcoast Bering hairgrass through the center portion, and Arctared red fescue and Nugget Kentucky bluegrass in the more distant rows.*

Species and Varieties	No Lime	Surface Lime	Tilled-in Lime
		%	
Annual ryegrass	27#	60	46
Athabasca oats	27	50	34
Weal barley	11	53	48

#Values are averages of three replications.

***Table 1**. Ground cover of annuals seeded on oil sludge/topsoil mix in 1986, as affected by lime treatment.*

Species and Varieties	Surface-Lime Treatment	Tilled-In Lime Treatment
1986 Summer Seeding	%	
Norcoast Bering hairgrass	63#	35
Arctared red fescue	52	25
Alkaligrass	42	25
Nugget Kentucky bluegrass	48	13
Nortran tufted hairgrass	45	17
Reed canarygrass	28	9
Engmo timothy	28	7
Aries hard fescue	30	0
Carlton bromegrass	28	0
Polargrass	18	1
Sourdough bluejoint reedgrass	14	0
1986 Fall Seeding		
Norcoast Bering hairgrass	92	37
Arctared red fescue	65	23
Reed canarygrass	43	8

#Values are averages of three replications.

***Table 2**. Ground cover on October 3, 1987, of perennial grasses seeded on lime-treated oil sludge/topsoil mix.*

Treatment	pH	Oil Content %	Oil Decline* %	N	P ppm[1]	K
Pre-mixing values (July 1, 1986)						
Oil sludge	4.7	4.0		18	8	103
Topsoil	7.0	0.2		56	4	41
No-lime treatment						
July 18, 1987	3.9	8.4		3	22	23
Oct. 3, 1987	3.4	7.2	14	7	35	35
Surface-lime treatment						
July 18, 1987	5.1	7.3		3	19	31
Oct. 3, 1987	3.8	7.0	4	6	25	37
Tilled-in lime treatment						
July 18, 1987	4.5	8.6		3	17	23
Oct. 3, 1987	4.1	7.0	19	5	35	35

* Percent decline in oil content from July 18 to Oct. 3, 1987.
[1] ppm = parts per million (multiply by two to obtain lb/acre in six-inch surface layer of soil).
[#] A number of samples were taken at random within each treatment and bulked for analysis.

Table 3. *Acidity, oil, and nutrient an analysis of oil sludge/topsoil mix according to treatment and date of sampling.*[#]

this two and a half month period. The fertilizer applied on July 18 most likely abetted this decline. Microbial decomposition of organic substances, including oil, has four requirements:

1) an energy source, in this case the oil;
2) a microbial population, which is indigenous in the soil;
3) essential nutrients, particularly nitrogen and phosphorus; and
4) satisfactory environmental and substrate conditions such as temperature, moisture and pH (acidity).

The application of lime to reduce acidity and fertilization with N, P, and K presumably provided the necessary factors for increased oil sludge decomposition rates and amelioration of the sludge-induced phytotoxicity. Presumably, the added fertilizer also accounted for the increase in the amounts of N, P, and K in the sludge/soil mix (Table 3). However, there appeared to be a general decline in pH as well.

Extractable nitrogen contents on October 3, 1987, were much lower than the original values on July 1, 1986, for both the sludge and topsoil (Table 3). Despite the addition of 120 lbs/acre of N on July 18, nitrogen measured only eight to 16 lbs/acre (2 x ppm) on October 3. This is attributed partially to leaching and denitrification losses and partially to its incorporation into dead and living microbial organic matter, thus indicating a high demand for N by the decomposers. There also is an indication of a relatively high use of potassium, though some loss may be due to fixation in clay minerals.

Soil samples taken from particular sites according to vigor of growth provided some interesting results (Table 4). Those sites that supported good to excellent growth had the lowest oil content and highest pH, with the converse being true for the poor growth and no growth sites. The poor growth on replication III of the lime treatments may be attributed to its relatively high oil content.

The oil content values associated with various degrees of growth provide us with an indication of threshold levels of tolerance for oil contamination by seeded plants. It appears that seedings can be accomplished on soils with about 7.5 percent oil content, with good growth occurring on soils containing less than 7.0 percent. An apparent adverse phenomenon, an increase in acidity (decline on pH), may have various causes, such as the addition of fertilizer, an accumulation of organic acids (products of decomposition) that are incompletely oxidized, and leaching of bases. Additional lime can be employed to counteract this tendency.

Specific Sites	pH	Oil Content %	N	P ppm	K
Excellent growth B II*	6.4	2.6	4	4	52
Good growth B II	4.0	6.8	7	6	28
Good growth C II	4.5	5.7	7	43	26
Poor growth B III	3.7	7.5	8	2	15
No growth C III	3.3	8.7	6	24	7

*B = surface-lime treatment; C = tilled-in lime treatment
II = second replication; III = third replication

Table 4. *Acidity, oil, and nutrient analyses of oil-sludge/topsoil mix from specific sites according to vigor of growth.*

Recommendations

The trial results demonstrate that land farming can be successfully employed to dispose of oil sludge. The strategy requires sufficient dilution of the sludge with soil, an abundant use of lime, and periodic applications of fertilizer. After spreading and incorporating the sludge, lime, and fertilizer should be tilled into the sludge/soil mix followed by additional applications of lime and fertilizer that are raked or harrowed into the surface. The fertilizer treatment should establish a good base level of all three major nutrients, N, P, and K. The results indicate that a concentration of lime in the surface soil material aids in establishment from seed. Lime should be incorporated as well to further ameliorate the high acidity. The low soil nutrient analysis, particularly N, at the end of the trial is interpreted as indicating the need for periodic applications of fertilizer to ensure continued microbial activity. Continued monitoring of soil pH is required to determine lime needs.

Initially, the use of annuals may be advisable to permit subsequent incorporation of more lime and fertilizer. This could be followed with a seeding of a more permanent cover, using available varieties of perennial grasses adapted for Alaskan use that performed the best in the trial, such as Norcoast Bering hairgrass, Arctared red fescue, Nugget Kentucky bluegrass, and Nortran tufted hairgrass.

It is interesting to note that the apparent threshold level of tolerance established for seedings in this study, about 7.0-7.5 percent oil content, agrees closely with that established in the earlier study (Mitchell et al; 1979). Some areas of the sludge study that initially appeared prohibitive evinced sufficient decline in oil content over the 15-month term of the study to become amenable to seeding. It is of further interest that live propagules can endure levels of contamination higher than those tolerated by seedings. This was demonstrated in other studies as well (W.W. Mitchell, unpublished data) where live plugs were transplanted into oiled soils.

Finally, the high acidity encountered in this study apparently is a consequence of the treatment producing the oil sludge. The application of untreated crude oil to soil has not produced high acidity in other Alaskan studies (W.W. Mitchell, unpublished data). ❑

Acknowledgement

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Appendix

Scientific names of entries included in the trial:

Annuals

Annual ryegrass	Lolium multiflorum
Athabasca oats	Avena sativa
Weal barley	Hordeum vulgare

Perennials

Norcoast Bering hairgrass	Deschampsia beringensis
Nortran tufted hairgrass	Deschampsia caespitosa
Arctared red fescue	Festuca rubra
Aries hard fescue	Festuca longifolia
Nugget Kentucky bluegrass	Poa pratensis
Engmo timothy	Phleum pratense
Alkaligrass	Puccinellia sp.
Carlton bromegrass	Bromus inermis
Polargrass	Arctagrostis latifolia
Sourdough Bluejoint reedgrass	Calamagrostis canadensis
Beach Wildrye	Elymus mollis
Water sedge	Carex aquatilis

History of the Alaskan Reindeer Industry and Its Problems with Land Use, Ownership, and Marketing

Gretchen M. Kerndt *

In Alaska for almost a century the reindeer industry has contributed to Native Alaskan socio-economic conditions as well as making an impact on Alaskan religious, political, and economic history. This diverse history chronicles everything from traditional herder economic practices to corporate capitalism. It resembles other Alaskan industries in that it has experienced the same boom-bust economic cycles. This paper looks at that history with respect to the problems of marketing, land use, and herd ownership which have made it such a fluctuating enterprise.

Historically, there have been four distinct periods of development in the Alaskan reindeer industry: the introductory years, 1891-1914; the years of rapid expansion, 1914-1933; the years of decline, 1933-1950; and the years of redevelopment, 1951-present.

To begin, it is necessary to have an understanding of what reindeer are. Reindeer have evolved from the domestication of the wild caribou of northern Europe and Asia. As a result of domestication, reindeer have become a separate subspecies of *Rangifer tarandus*. They can interbreed with caribou (Stern et al., 1980). There are relatively few behavioral and morphological differences that aid in distinguishing between reindeer and caribou. Reindeer tend to be smaller than the caribou, and often reindeer are lighter in color with a greater tendency to be spotted (Stern et al. 1980).

Reindeer use a diet of various lichens and mosses during the winter and early spring. A variety of grasses, marsh plants, and willow and birch leaves constitute the reindeer's summer diet (Stern et al., 1980). In part, it was reindeer nutritional requirements that led Sheldon Jackson in 1891 to see reindeer as a way to increase the value of the barren tundra of the Seward Peninsula. This great expanse of land offered prime reindeer habitat.

Jackson, a Presbyterian missionary and the U.S. General Agent for Education in Alaska, was credited with the introduction of reindeer. When Jackson first arrived in the arctic area, he was dismayed by what he saw. The Native population at the time was surviving on a dwindling resource base, perceived to have been depleted in part by the influx of miners and whalers. Jackson saw the introduction of the reindeer as a benefit to the Natives. He hoped "to stock Alaska with reindeer, to reclaim and make valuable millions of acres of moss-covered tundra, to introduce a large permanent and wealth-producing industry where none had previously existed, to take a barbarian people, on the verge of starvation, and lift them up to comfortable self-support and civilization." (Jackson, 1892)

Jackson felt that reindeer would provide subsistence for the Native population as well as a way for Natives to become self-supporting in a changing cultural and socio-economic world. With the intention of creating a stable food supply for Native inhabitants, Jackson received funds from the government to import 171 reindeer from Siberia to a newly created reindeer station at Port Clarence in 1892. The reindeer successfully adapted. Congress appropriated money for additional reindeer importations and for program administration. Within the next decade 1,280 reindeer were brought to Alaska from Siberia (Stern et al., 1980). In 1902 the Russian Czar forbid further reindeer export from Russia. However, by this time there were 5,148 reindeer in Alaska due to

In the Alaskan reindeer industry's first four decades, both Alaskan Natives and non-Natives owned reindeer herds. Technical support was given to owners by government specialists. © Lomen Family Collection, Alaska and Polar Regions Dept., University of Alaska Fairbanks.

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natural proliferation. It was Jackson's policy to give the reindeer to missions at first in an attempt to "civilize" the Natives; Natives would have to come to the missions for food and clothing gotten from the reindeer. Reindeer were subsequently distributed to Natives through an apprenticeship program.

Shortly after the reindeer introduction, several problems developed. When reindeer were initially imported from Russia, the federal government employed Siberian herdsmen to teach Eskimos herding skills, but that proved to be a failure, in part because of traditional animosity between Siberians and Alaskans (Stern et al., 1980). In 1894, six Lapps from northern Scandinavia were brought to the Seward Peninsula to teach Eskimos reindeer herding and husbandry. It was evident from the start that the Lapps where given preferential treatment over the Eskimo apprentices. Lapps were given reindeer and were permitted to slaughter deer. In the early years of reindeer introduction, Natives were not permitted to slaughter (Olson, 1969). This preferential treatment of the Lapps, combined with yearly radical changes in the apprenticeship program, created doubt among the Eskimo as to who really was benefiting from the introduction of reindeer. By 1905, the average herd size for the Lapps was 238 head per herder; it was only 59 head per Native owner (Olson, 1969).

During the heyday of the reindeer industry, slaughter plants supplied both the local market around Nome and exports to the Lower 48. © Lomen Family Collection, Alaska and Polar Regions Dept., University of Alaska Fairbanks.

Even Jackson saw a change in the original intent of reindeer introduction. The demand for reindeer increased with the flood of miners and entrepreneurs during Nome's gold rush days. Reindeer became important as a means of transportation and pack animals as well as a source of food. In the Thirteenth Annual Report on Introduction of Domestic Reindeer into Alaska-1903, Jackson's words indicate this shift from Native to white benefit.

> *"The ordinary white man is unwilling to undergo the drudgery of herding in that rigorous climate and unwilling to work for small compensation that is paid for such services. He can do better. His directive ability can be more profitably employed as merchants and manager of transportation in employing and directing the trained Eskimo herders and teamsters... It will become possible for white men to own large herds but the men that will do the herding and teaming will always be the Eskimo and Laplanders."*
> (Olson, 1969)

Had it not been for the discovery of gold and the formation of a wage economy in services supporting the mining industry, reindeer would probably never have become such a focal point for cultural change.

Governmental investigations into the extensive ownership of reindeer by the missions and non-Native Lapps, and the lack of benefit going to Natives, resulted in a federal effort to put reindeer into as many Eskimo hands as possible. Even though they were able to achieve this by loaning deer to Eskimos from the mission- and government-owned herds, the numbers allotted to individual Natives—an average of 48 head per herder—were insufficient for a commercially productive herd. In essence, the government's effort to put more deer into Eskimo hands actually contributed to the downfall of the enterprise as a commercial effort for the Native (Stern et al., 1977).

The introduction years of reindeer herding saw a change in emphasis in ownership of the herds. What was initially intended to provide a socio-economic base for Eskimo Natives, was soon controlled by government, missions and Laplanders. However, this also changed with government involvement. By 1915, 66 percent of the 70,243 reindeer in northwestern Alaska, were in Native ownership. Gold miners created a booming local market during this phase. Reindeer meat sold for 40 cents a pound. A sled reindeer went for as much as $150. Herds at this time were located as close to the coastal population centers as possible. With the small, constantly tended herds, deer became accustomed to the range they inhabited (Olson, 1969). Some pressure on the range from over-grazing could be seen by the end of the introduction phase with its rapid proliferation of reindeer, but over-grazing was not considered extensive. As the reindeer industry entered its phase of rapid expansion, the tendency to exclusively use coastal ranges compounded the over-grazing problem in coastal areas (Olson, 1969).

The period from 1914 to the early 1930s marks a time when Native interest in reindeer herding and ownership were great. Non-Native ownership of herds also expanded. Non-Native owners were primarily interested in the commercial export market of reindeer meat and meat products.

Reindeer fairs, starting in 1915, provided a social event centered around reindeer. Fairs also created an opportunity for Eskimo herders to get together and discuss changes and problems with reindeer herding. These fairs provided the Bureau of Education, which at that time oversaw reindeer affairs, a perfect opportunity to urge Native owners to band together to form associations to set prices and allocate portions of the market among themselves. These associations also evolved in the response to the insurmountable problem of keeping growing herds separated on overlapping ranges. Joint stock companies evolved issuing one share of stock per deer owned to each member-owner (Olson, 1969).

During this time, the Lomen family, established business owners and merchants in Nome and other Seward Peninsula villages, became the largest and most influential non-Native reindeer owner. Between 1914 and 1929 the Lomens purchased 14,023 reindeer from mission and non-Native herds (Stern et al., 1980). In addition to owning herds, the Lomens attempted to control the supply, storage, and distribution of reindeer products by constructing cold storage plants at various sites on the peninsula, freighting offices along the coast, and slaughter facilities in Nome. Even though it was the Lomens' policy to leave the local markets to the Native herders, and deal purely with exports to the Lower 48, their expansion came at a time when reindeer numbers were at their peak. At the same time, local markets were declining as mining declined. Twenty years earlier mining stimulated the reindeer industry. Herders, indebted to the Lomen Company stores which had extended them credit, were forced to pay the store in reindeer at a value of $2.00 a head.

Such market control by the Lomens created tension between Native and non-Native owners. Again Natives were not benefiting from the reindeer industry as originally planned. The Great Depression of the 1930s brought financial troubles to the Lomens as exports to the lower 48 states dried up. Government investigation into the legality of the Lomen operation culminated in the Reindeer Act of 1937 which forbids the non-Native ownership of reindeer. By 1940 the federal government had purchased all non-Native owned reindeer herds and the animals were turned over to Native herders (Stern. et al., 1977).

These changes came when reindeer herds were at their peak in numbers. It was estimated that there were 640,000 reindeer in Alaska at the beginning of the 1930s but, for a variety of reasons, a precipitous decrease began, leaving only 250,000 by 1940. By the end of 1950 there were just 25,000 reindeer.

From 1933 to 1950, there was a decline in the reindeer industry as a whole. There are many viewpoints as to the principal cause for the vast decline. Since most of the herds were concentrated on the coast, the natural tendency for the deer to habitually use the same range, resulted in large areas being over-grazed. Starvation, predation by wolves, large scale straying with caribou herds, and herding inadequacies also contributed to the decreased numbers (Olson, 1969). The reluctance of Eskimo herders to change their lifestyle to one of a nomadic nature requiring them to live away from their villages was another contributing factor. A loss of interest by Native owners as a result of unsatisfying association-stock ownership also contributed to the reindeer industry decline in the beginning of this period (Olson, 1969).

Although the Reindeer Act of 1937 resolved the problems related to reindeer ownership, interpretation of its rules and regulations delayed the industry's reorganization. It was not until the late 1940s that a definite policy for the loaning of reindeer to qualified Natives was even formalized (Stern et al., 1977).

The latter half of this period saw the reintroduction of individual ownership by herders showing the greatest interest and potential in reindeer herding. A greater interest was taken on the part of the Bureau of Land Management (BLM) to actively supervise range utilization and allocation. This trial-and-error period of new herd establishment resulted in the formation of several relatively stable herds (Stern et al., 1980).

The market for reindeer products was limited to local markets, but by the 1950s government sales within Alaska and to the lower 48 states became increasingly significant (Olson, 1969).

The 1960s brought a revived interest statewide in the processing and marketing of reindeer. Cooperative agreements were made in 1968 among the Bureau of Indian Affairs (BIA), BLM, and the State of Alaska which resulted in a division of labor and responsibility in matters relating to the reindeer industry (Olson, 1969).

The BLM was responsible for the supervision of range utilization and protection through the issuances of grazing permits and monitoring of range conditions. Starting in 1962, BLM issued permits for 10-year periods.

The BIA managed the training and ranching aspects of reindeer herding until 1968, when it initiated a withdrawal from its active role in the industry. Their main interest today is to fund the operation of the Reindeer Herders' Association which was formed in 1971 (Stern et al., 1980).

At the state level, support has been given in the guidance and promotion of the processing and marketing of the reindeer products. The Department of Commerce and Economic Development aided in the construction of a reindeer slaughtering and processing facility in Nome in 1969. Special research, development and experimental projects were started by researchers from the University of Alaska which have resulted in improved overall herd management. In cooperation with the Reindeer Herders' Association, the Alaska State Department of Commerce and Economic Development compiles economic statistics on the industry which aids in understanding the marketing of reindeer.

One of the most important boosts to the industry came in 1969, when the oriental market developed for antlers in the soft-velvet stage. In the beginning, antlers brought $1 per pound. Prices have been as high as $50 per pound. Currently, the price is about $35 to $40 per pound. The antler market provides a cash income to herd owners without having to slaughter the animal.

Passage of the Alaska Native Claims Settlement Act, (ANCSA), in 1971 and the Alaska National Interest Lands Conservation Act, (ANILCA) in 1980, have clouded the complex issue of land ownership. Instead of just one jurisdiction, rangelands now are managed by the State of Alaska, village and regional Native corporations, the National Park Service, and BLM. While BLM remains the initial grantor of five-year permits, coordinated research management plans (CRMP), involving input from all land-owning entities, have been developed to maximize range use while trying to prevent over use of the ranges. With help from the Soil Conservation Service in implementing the plans and educating herders on sound range management practices, a rotational grazing pattern has been encouraged (Swanson, 1989). Since most available grazing permits have been allotted, increases in herd sizes are limited to rangeland availability.

The short-term market for reindeer has been promising; both meat and antler sales have been relatively stable and consistent. However, long-term markets are limited by problems that have plagued the industry since the turn of the century.

One of these problems is the remoteness of herds to slaughtering and processing facilities. Slaughtering facilities are limited. Although many small airports have been constructed in remote sites in recent years, lack of inexpensive transportation methods to markets beyond the consistent local demand of village residents has blocked the capital investment needed to ship meat to farther markets (Robertson, 1970).

Another problem is the lack of cold storage facilities to accommodate the many carcasses needed to provide an adequate supply to meet the year-round demand of reindeer meat. Since reindeer are slaughtered only during the fall and winter, there is not a constant flow of meat to distributors throughout the year, nor can current facilities handle the storage of a year's meat supply.

The need for federal inspection of meat has presented a problem to the reindeer industry. An inspection of the deer prior to slaughter is required, as well as during the processing if meat is to be shipped to markets outside of Alaska. Remoteness of where slaughtering occurs makes inspection nearly impossible (Arobio, 1989).

Differences in the philosophy among owners have contributed to a lack of cohesiveness in commercial development of the reindeer industry. Some herders view the ownership of reindeer as a means of subsistence and as a result, do not tend their herds full time. There is no driving force for these owners to expand their markets when a consistent demand in the rural village provides adequate income from their part-time reliance on reindeer herding. For others the focus of a greater market outside local markets is appealing. They manage their herds constantly as a sole supporting enterprise (Dieterich, 1989). However, they find it difficult to open vast markets with limited herd sizes and lack of capital to invest in marketing promotion.

In conclusion, the reindeer industry has had a history of boom-bust affected by the ownership of reindeer, the use of rangeland effectively and the marketing of the reindeer products. Even though these problems have been addressed throughout history, changes in social norms and economic climates continue to prevent the solution to all these problems. There is a great potential for the reindeer industry but more cooperation between managing agencies and herd owners will be needed before it will reach that potential. ❑

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A Profile of Interior Alaska Dog Mushers

Alan Jubenville *
William G. Workman **
Amy Smith ***

While not uniquely Alaskan, dog mushing is an important sport and focal point for social interaction during the winter in the state. The Iditarod Trail Dog Sled Race is now world famous, and Fairbanks annually hosts what is arguably the world championship of dog mushing races, the Open North American Sled Dog Championship. Other significant events are the Anchorage Fur Rendezvous and the Yukon Quest International Sled Dog Race.

But dog mushing in Alaska is more than these glamorous media events. It is part of the state's social fabric. Local weekend races and recreational outings have captured the interest of a growing number of participants and spectators alike. Like any activity of this nature, financial and resource impacts are distributed across the region. With this in mind, we decided to take a look at dog mushing in Interior Alaska to make an initial assessment of its impact by looking at the profile of dog mushers and some of the important management issues. The results are based on a survey conducted in 1987.

Major dog racing events, such at the Open North American, thrill both competitors and spectators during interior Alaska's winter months.

Methods

The intent of the study was to first develop a profile of the mushers in terms of their background, participation patterns, and costs of operation. Secondly, we wanted to identify important resource conflicts and preferences for management programs.

The original list of dog mushers to whom the survey questionnaire was sent was developed using a "snowball" or chain referral technique (Biernacki and Waldorf, 1981). This technique was adopted because lists of those belonging to dog mushing associations were not available and many mushers do not belong to associations. Flyers asking people to participate were made available at a special dog mushing exhibit at the University of Alaska Museum, at feed stores, and at local clubs. In addition, a news article was published in the *Fairbanks Daily News-Miner* and feed store newsletters asking people to volunteer to participate in the study. Once a person volunteered, he/she was asked for names of additional mushers whom we could contact. This resulted in a total sampling frame of 400 dog mushers.

A pretested mail questionnaire was sent to all 400 previously identified mushers on October 7, 1987, with a follow-up postcard on October 10, 1987. A total of 199 questionnaires were completed and returned, but not all questions were answered by all respondents. Thus, the total response to any one question may be less than 199. In the subsequent section, these non-responses are reported as missing data.

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Results

Profile of Dog Mushers: Respondents were asked to classify their mushing activities within the categories: racer, recreational musher or combination. Fifty-seven percent placed themselves in the combination category. Twenty-four percent classified themselves as racers, and 19 percent said they were recreational mushers.

Information relating to years of experience is summarized in Figure 1. The typical respondent had more than four years of experience, suggesting that there is longevity in the sport. Because of the commitment of time and money, it is not a sport one would casually enter.

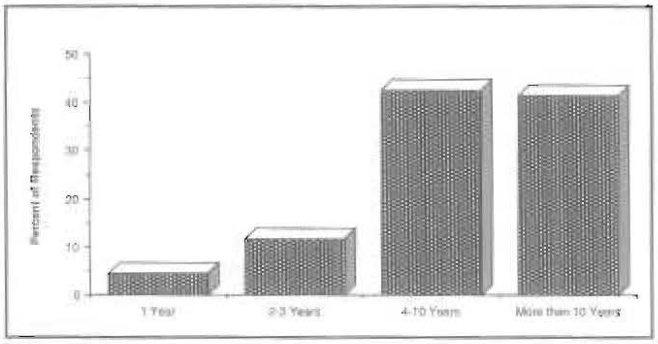

Figure 1. Years of Mushing Experience.

The annual household income distribution for the respondents is shown in Figure 2. Average annual income exceeded $35,000.

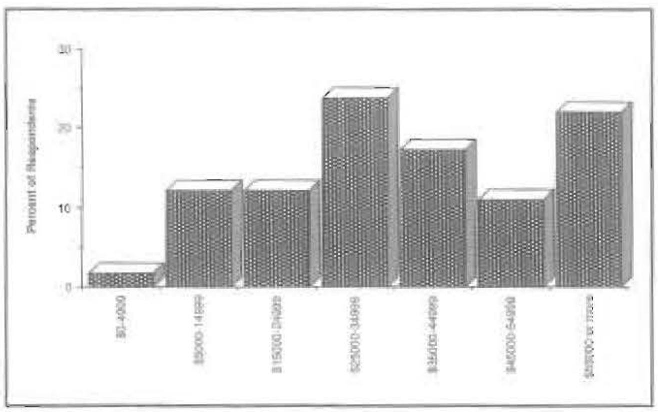

Figure 2. Annual Household Income of Respondents, 1987.

Distribution of total annual operating expenses for the participants is shown in Figure 3. Those reporting no expenses typically harvested and dried fish for dog food, and did their own veterinarian care. The mean annual operating expense was $5,127. There was no significant relationship between income and annual operating expenses. However, there were some interesting cases such as three respondents whose incomes were less than $5,000 but who reported annual operating expenses of nearly $2,000. Nine respondents reported expenses over $8,000. Part of the variation in expenses no doubt reflected differences in the size of kennels (number of dogs owned).

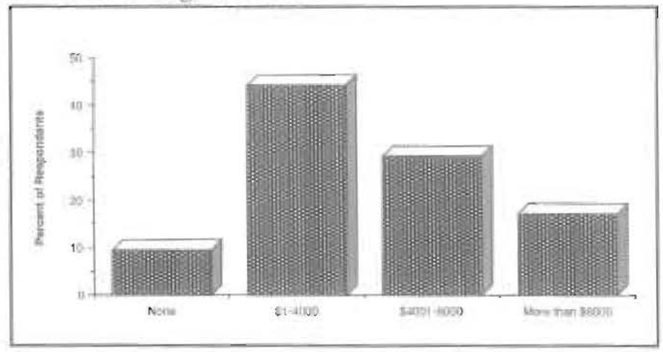

Figure 3. Total Annual Operating Expenses. (Major equipment purchases are not included.)

The majority of annual operating expense goes for dog food (Figure 4).

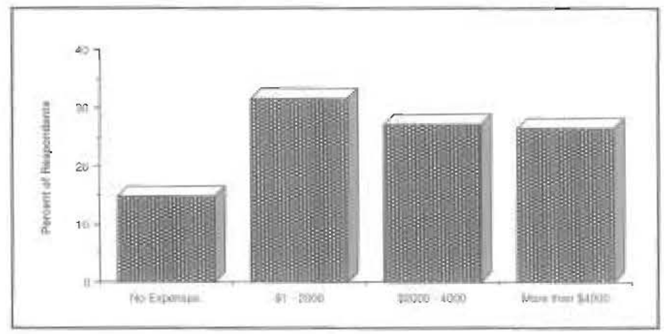

Figure 4. Annual Dog Food Expenses.

The no expense response represents catching and drying fish for dog food. There is such a demand for specialized dog food to meet the needs of sled dogs in Interior Alaska that local feed stores have developed their own diet. Nutritional studies have been conducted here in the School of Agriculture and Land Resources Management to test the nutritional value of some of these products.

Annual veterinarian expenses represent the second major dog mushing expense (Figure 5).

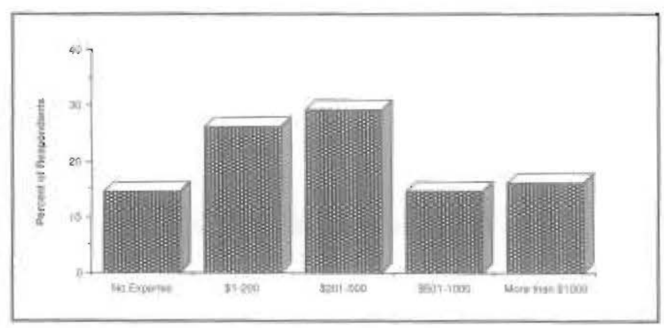

Figure 5. Annual Veterinarian Expenses.

The veterinarian expenses are reduced in some cases by the musher administering first aid, pills or shots, and home recovery, rather than having the veterinarian do it. In these cases, veterinarian expenses represent the cost of prescription medicines and major medical problems.

The third largest expense category was dog purchase or breeding (Figure 6). Nearly half of the dog mushers reported no expense in this category for the 1986-87 season. These expenses were significantly related to whether one was a racer or recreational musher. The tendency was for the recreational musher to have low or no dog purchase/breeding expense; the racers had higher expenses.

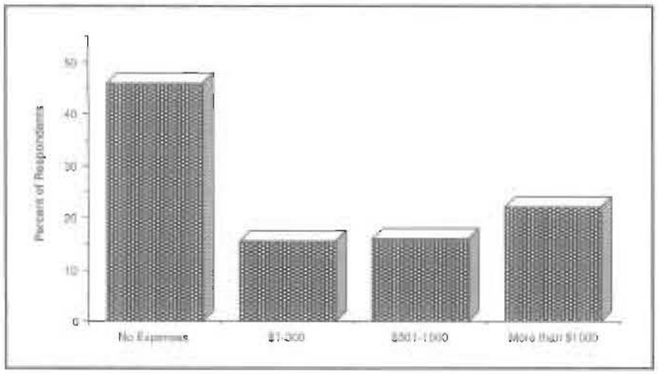

Figure 6. Annual Dog Purchase or Breeding Expenses.

The modal range of frequency of participation was three to six outings per week during the peak of the winter season. Early season trips tended to be short with distances increasing in late winter/early spring (Figure 7).

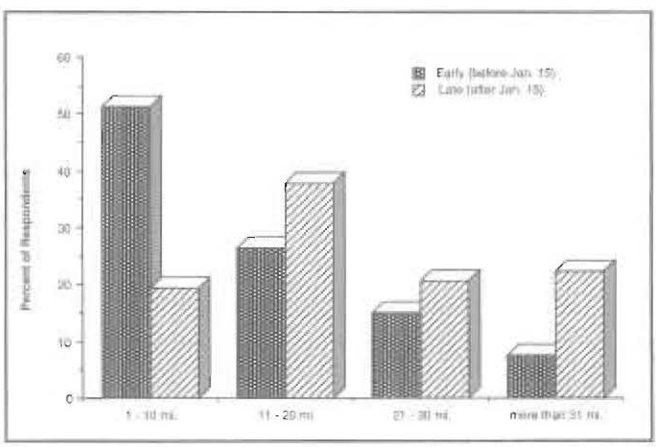

Figure 7. Distance Per Trip, Early and Late Season.

Management Program Preferences: Most respondents preferred not to have additional facilities or management programs as long as there were trails available to them (Figure 8). The majority of racing mushers prefer trail markers whereas the majority of the recreational mushers do not. This relationship was statistically significant. Preference for agency-provided maps was also statistically significant in relation to musher types, with recreational mushers wanting maps and racers not.

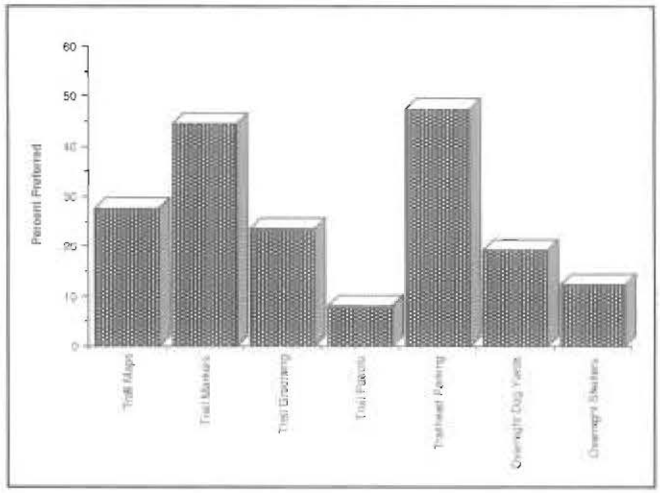

Figure 8. Management Program Preferences.

Resource Issues: Mushers were asked to identify their current areas of use. These use areas were combined into the more general categories as shown in Table 1. Figure 9 shows respondents residing in urban areas indicating that they had chosen residence in order to mush, while respondents from the more remote areas of Interior Alaska did not. This relationship was statistically significant.

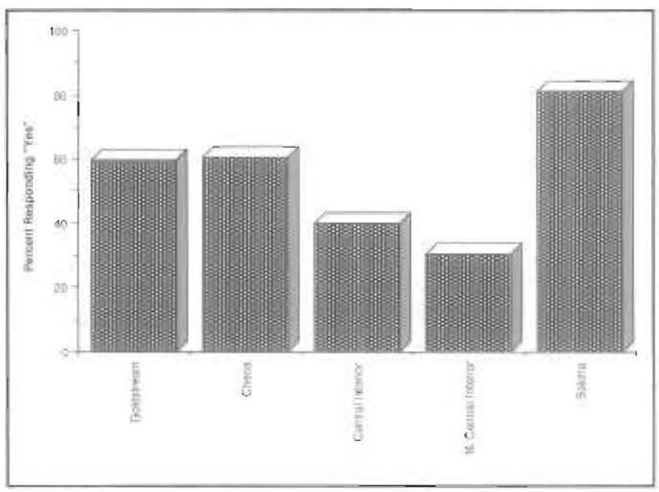

Figure 9. Chose Residence in order to Dog Mush.

Table 2 shows the geographic dispersion of dog mushing activity in relation to residence. There is very little dispersion away from the residence zone. Thus, while there is an urban-rural difference in terms of

URBAN AREAS	
GOLDSTREAM	***CHENA***
Goldstream	Chena Hot Springs Road
Murphy Dome	Nordale/Chena
Ester	North Pole
Farmers Loop	Tanana River
Chatinika River	Fairbanks
Rosie Creek	Chena Marina
RURAL AREAS	
SALCHA	***N. CENTRAL INTERIOR***
Salcha	Manley, Eureka
CENTRAL INTERIOR	Circle, Central
Tok, Tetlin	Tanana, Bettles
Galena, McGrath	Koyukuk
Healy, Denali	Brooks Range
Delta, Shaw Creek	Ft. Yukon
Minto Flats	Coldfoot
Chistochina	

Table 1. Mushing and Residence Area Categories.

Mush Area	Residence Area: Goldstream	Chena Area	Central Interior	N. Central Interior	Salcha	Row Total
Goldstream Area	41* (87.2)	9 (12.1)	0 (0.0)	2 (7.7)	0 (0.0)	52
Chena Area	5 (10.6)	60 (81.0)	2 (6.7)	2 (7.7)	0 (0.0)	69
Central Interior	0 (0.0)	1 (1.0)	28 (93.3)	1 (3.9)	0 (0.0)	30
N Central Interior	0 (0.0)	3 (4.9)	0 (0.0)	21 (80.7)	0 (0.0)	24
Salcha, Other	1 (2.2)	1 (1.0)	0 (0.0)	0 (0.0)	18 (100.0)	20
Column Total	47	74	30	26	18	195

* Numbers in parentheses are percent of column total.

Table 2. Current Mushing Area by Residence Area.

choosing one's residence to dog mush, all dog mushers essentially conducted their activity entirely within their residence zone.

There was little perceived conflict with other users other than with snowmobilers. Sixty-one percent of respondents perceived moderate to severe conflict between their dog mushing and snowmobiling. There was a statistically significant pattern of more perceived conflict by racers and less by recreational mushers.

Summary

Our initial look at dog mushing in Interior Alaska revealed an activity dominated by participants with considerable years of experience. More than half of the mushers surveyed reported annual household income in excess of $35,000. Average annual operating expenses exceeded $5,000, with expenditures on dog food accounting for a large part of this cost.

Participation patterns show length of trips increasing as the winter progresses. Mushers expressed little interest in management programs other than the availability of trails. Most dog mushers participate near their residences with those in the urban areas indicating that access to mushing opportunities was a factor in the choice of home site. Finally, more than half of the mushers surveyed see a moderate-to-severe conflict between dog mushing and snowmobiling in areas where these activities co-exist. ❑

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Hulless Barley and Crab Shell in Diets Fed to Steers

Fredric M. Husby *

Feedstuffs produced and available in Alaska to formulate diets for livestock production are limited to two cereal grains for energy (barley and oats), marine by-products for protein (meals produced from seafood processing wastes), and a few roughages (grass hay or silage, brassicas, faba beans and crop residues, like straw). Of the two cereal grains, barley is the most important one grown in Alaska (Wooding, 1977) and like its principle use worldwide and in the lower 48 states, it is predominantly utilized for animal feeding.

For ruminants, barley has a feeding value that varies from 85 to 95 percent the feeding value of corn or sorghum. The variation in feeding value is related to the type of production or growing location. There is limited information on the relative feeding value of barley grown in Alaska when included in beef cattle finishing rations. The lower feeding value of barley when compared to corn is partly due to a higher fiber, lower starch, and lower digestible energy content. Hulless cultivars of barley contain less fiber (Husby and Krieg, 1987) and more starch and therefore, may have a feeding value roughly equivalent to corn and wheat. However, not much hulless barley is produced in the world and only limited information is available concerning the feeding value for livestock.

A hulless cultivar 'Thual' was developed in Alaska by R.L. Taylor and released in 1981 (Taylor, 1985). This introductory cultivar was intended to be characteristic of the hulless type and to contain significantly lower fiber content due to the loss of the hull during threshing and it was assumed that the hulless barley may contain greater concentrations of available energy when included in livestock diets. An indication that Thual may provide greater available energy in ruminant diets was reported by Husby and Krieg (1987) when an In Vitro Dry Matter Disappearance (IVDMD) of 90 percent for Thual was compared to a 76 percent IVDMD for Alaskan covered barleys. Thual is a six-row cultivar and is only one of three hulless barleys currently with suitable yield and disease resistance to meet criteria for commercial production in North America. The other two hulless cultivars are 'Scout' and 'Tupper' from Saskatchewan, Canada. Canadian research has indicated that 'Scout' is superior to covered barley (Thacker et al., 1987) and 'Tupper' is equal to wheat for growing-finishing pigs (Bell and Keith, 1988). However, research conducted at the Alaska Agricultural and Forestry Experiment Station failed to demonstrate any difference in performance of growing-finishing pigs or 4- to 8-week-old starter pigs when Thual was compared to a covered cultivar (Husby, 1987b; Husby, 1989). Research conducted with sled dogs has demonstrated significantly greater dry matter digestibilities for diets containing Thual than covered barley (Husby, 1986). Canadians have reported poor performance of broiler chicks fed hulless barley but that egg production was equal when laying hens were fed hulless barley or wheat-based diets (Classen et al., 1985; Classen et al. 1988). With the exception of an Alaskan report by Krieg and Husby (1986) that growth performance of lambs was similar when fed hulless or covered barley, no information is available concerning the feeding value of hulless barley for ruminants.

Feeding problems for beef cattle may be associated with high-concentrate grain diets such as barley. These problems may include cattle going off feed, acidosis, founder, liver abscesses, bloat, and diarrhea. Rapid rumen fermentation of starch from processed grain can decrease rumen pH, reduce cellulolytic activity, and cause rumenitis (Orskov, 1979). Wheat starch is highly soluble in the rumen and lowers pH at a rapid rate but the solubility of starch from hulless barley has not been determined. A continued high level of growth and feed performance may be maintained by including 10-15 percent of the diet as roughage. Dietary roughage will stimulate rumen papillae. In addition, saliva production associated with the chewing of the fiber should buffer the acids formed by rapid starch breakdown and stabilize the rumen environment. In Alaska, roughage may be an expensive ingredient and is low in availability in the coastal areas of the state where cattle are raised. The coarse shell material of crab meal (separated physically at screening as material greater than 40-mesh) may possibly be utilized as a dietary fiber source in cattle rations containing hulless barley.

Prior to the decline of the crab and shrimp fisheries, Alaskan fish meal plants annually produced about 4,000 tons of shellfish meal (Husby, 1987a). Crab meals have been shown to be of value as a protein source for swine (Husby, 1980; Husby et al., 1981) by replacing 50 percent of imported soybean meal in barley-based growing pig diets, for lactating cows by including 7.5 percent as total ration dry matter (Brundage et. al., 1981a; Brundage et al., 1984), for beef cattle with dietary levels not to exceed 10 percent of barley-based diets (Husby et al., 1981; LaFlamme, 1988), and as a free-choice protein supplement for low-quality hay for winter feeding of weanling calves (Husby et al., 1981). The above recommendations are based on slow rumen adaptation and limited palatability for crab meal (Brundage et al., 1981b; White, 1981). Although crab meal was limited to a 50 percent replacement of soybean meal in swine diets, the fine material from crab meal passing through

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a 40-mesh sieve following physical separation had improved nutritional quality and replaced 100 percent of the soybean meal in similar barley diets (Husby, 1980). The remaining coarse material or crab shell (less than 40-mesh) contained a greater level of chitin, a polysaccharide in crab shell, that was determined by acid detergent fiber analysis (Van Soest, 1963) to be a fibrous component of shellfish meals (Stelmock et al., 1985). Patton and Chandler (1975) and Patton et al., (1975) reported that blue crab meal and chitin could be digested by young ruminating calves. In vitro studies by Ortega and Church (1979) indicated limited conversion of chitin to volatile fatty acids. However, following a six-week adaptation to a tanner crab meal diet, both in vitro (Tilley and Terry 1963) two-stage digestion and in vivo nylon-bag digestibility techniques (Mehrez and Orskov, 1977) indicated that up to 21 percent of the chitin content may be degraded by rumen microorganisms in the first 48 hours (White, 1981). Results from total digestibility studies with beef cattle indicated that some of the chitin was utilized when crab meal replaced 15 percent of bromegrass hay in maintenance diets (Husby and Morrow, 1988). Preliminary observations of a study with rumen microorganisms in enrichment cultures containing 10 percent ground crab shell as the sole carbon source indicated that an anaerobic fungus was the predominant organism for degrading the crab shell (Husby and Yokoyoma, 1989).

The objectives of this study were: 1) to compare tanner crab shell to chopped bromegrass hay as a potential roughage source in hulless barley diets for finishing beef steers, and 2) to compare Thual barley to corn as the sole grain source in diets for finishing beef steers.

Materials and Methods

General: These two growth trials were conducted over a three year period with Trial I replicated in 1986 and 1987 and the first replicate of Trial II completed in 1988 with the second replicate scheduled for the 1989-90 winter. The steers were penned individually in partially slotted concrete floor pens of 100 sq. ft. in an enclosed barn with a minimum winter temperature maintained at 45 degrees F and with ambient spring and summer temperatures. Prior to both trials, steers were injected intramuscularly with 1,000,000 and 150,000 IU of vitamins A and D, respectively and had been vaccinated at weaning for the respiratory complex diseases (BVD, IBR, PI_3), leptospirosis, enterotoxemia and/or blackleg-like diseases, and treated for internal parasites with Tramisol. At the start and termination of the trials, all animals were weighed on two consecutive days; the mean live weight was used as the initial and final weight. Data on growth and feed intake were collected. As stockers, all the steers received free-choice bromegrass hay and 60:40 blend of trace mineral salt with calcium and phosphorus. The experimental mixed diets were introduced at four lb/head/day and increased daily by 1/2 lb/head with a subsequent reduction in hay until full feed levels were attained in approximately 21 days. Steers had ad libitum access to fresh water and fresh feed that was offered daily. Orts were collected and weighed biweekly. Barley was coarse ground and mixed with chopped bromegrass hay (approx. three inches) or crab shell at a 85:15 ratio (concentrate to roughage, dry matter basis) and minerals. All diets were formulated and mixed as complete simplified diets. No growth promotants (implants) or feed additives (antibiotics) were included in these dietary treatments.

Trial I: Ten heavy Hereford steers (916 lb.) were randomly allotted to two dietary treatments in a 122-day trial to compare crab shell to bromegrass hay as a roughage supplement in hulless barley diets. Complete simplified diets (table 1) were formulated to provide an 85 percent grain concentrate to 15 percent roughage ratio with a single grain source and within that ratio to at least meet or exceed the National Research Council (NRC) nutrient requirements for crude protein and minerals. The test diet was formulated to contain tanner crab shell rather than chopped bromegrass hay. Tanner crab shell was produced from tanner crab meal produced commercially from raw processing wastes by grinding, drying in a Norwegian-type steam multiple coil dryer, remilling, and adding antioxidant. The meal was separated through a 30-mesh screen (600 micron hole size) with a Roto-Sieve. Rumen fluid samples were collected via stomach tube from all steers on the final day of the feeding trial and pH determined with a Corning 140 pH meter.

Trial II: Six Hereford steers (704 lb.) were randomly allotted to two diets for a 127-day feeding trial to compare Thual barley to corn as an energy source in beef cattle finishing rations. Complete simplified diets (table 1) were formulated to maintain an 85:15 (concentrate to roughage) ratio throughout the feeding trial. At that ratio, the Thual barley-bromegrass-mineral diet provided adequate energy but exceeded the crude protein NRC requirement for 700 lb. steers. Therefore, to maintain similar diets throughout the trial, the corn-soybean meal-bromegrass-mineral diet was formulated to be approximately isonitrogenous, isocaloric, and isofibric with the barley diet.

Chemical and statistical analysis: Ingredient dry matter (DM), crude protein (CP), calcium, and phosphorus were analyzed as described in AOAC (1980) and Brundage et al. (1981a). In vitro dry matter disappearance (IVDMD) (Tilley and Terry, 1963) acid detergent fiber (ADF) (Goering and Van Soest, 1979) and chitin (Stelmock et al., 1985) analyses were conducted on both roughage sources. Differences between means for growth and feed performance were assessed by comparison of the two sample means, unpaired observation, equal variances (pooled t-test) (Steel and Torrie, 1960).

Results and Discussion

Thual barley utilized in these trials averaged 12.5 percent CP and 1.9 percent ADF. This fiber level is considerably less than the average of Alaskan covered barleys at 7.8 percent ADF (Husby and Krieg, 1987). Although the starch solubility of Thual was not determined, the high test weights of 58-60 lb/bu would indicate a high starch content. When ground and included in steer diets, this lower fiber and greater starch content of Thual may have contributed to the relatively low rumen pH (5.2 & 5.8) for Thual plus crab shell or bromegrass hay diets, respectively (table 2). Although these rumen pH were considered low, no feeding problems such as rumenitis (Orskov, 1979) developed during the study.

Tanner crab shell (less than 30 mesh) contained 35 percent CP, 40 percent ADF, 21 percent chitin, 49 percent ash and a 75 percent IVDMD on a DM basis and was not different in composition from coarse crab shell produced by a 40-mesh screen as reported by Husby (1980) or Stelmock et al., (1985). Bromegrass hay contained less CP (11.1 percent) and ADF (34.6 percent) but approximately 30 percent of the crude protein in crab shell is calculated from nitrogen bound to the chitin molecule (Stelmock et al., 1985). Crab meal nitrogen has been reported to be low in rumen solubility (Brundage and Husby, 1982; Brundage et al., 1979). Therefore if the diets in Trial I (table 1) were adjusted for the contribution of chitin-nitrogen, the protein contents should be similar. In addition, the greater ash content of crab shell contributed to the higher calcium and phosphorous levels in the barley-crab shell diet (table 1) and resulted in a calcium to phosphorous ratio of 3:1, but the minimum NRC requirements for these steers were met for CP, calcium, phosphorus and metabolizable energy. The composition of the diets in Trial II are similar in CP, calcium, phosphorus, metabolizable energy, fiber level, and physical form of the fiber since the major contribution of fiber was from the bromegrass hay.

Trial I: Steers receiving the bromegrass diet gained greater than 100 lb. per head more than steers fed the crab shell diet during the 122-day feeding trial (table 2). Steers fed the bromegrass diet had significantly greater ($P<.05$) daily weight gains and a significant ($P<.05$) improvement in feed efficiency. Daily feed consumption was reduced in steers fed the crab shell diet and this reduction in daily feed intake occurred throughout the entire feeding trial. Reduced intake and limited palatability of diets containing high levels of crab meal were previously reported by Brundage et al. (1981b), Brundage et al. (1984), and LaFlamme (1988) and resulted in recommendations of no greater that 7.5 and 10 percent crab meal in the total rations for lactating dairy cattle and beef cattle, respectively (Brundage et al., 1984; and Husby et al., 1981). The poor feed performance may have been related to the low nitrogen solubility of crab meal (Brundage and Husby, 1982; Brundage et al., 1979) or to the need for a longer dietary adaptation period. White (1981) demonstrated that chitin digestibility was only about 2.5 percent in cattle that had not previously been exposed to crab meal diets, but increased to 20.8 percent in cattle following a six-week adjustment period to diets with crab meal. The 15 percent crab shell supplementation utilized in this trial exceeded the previous recommended levels but was done to provide the same concentrate to roughage ratio of the barley to bromegrass diet that represented standard accepted practices for high concentrate diets.

White's (1981) results further suggested that chitin-utilizing microorganisms in the rumen were inducible in the presence of crab meal-chitin and that crab meal may be more efficiently utilized in diets with relatively small amounts of available carbon (grain) sources. Chitinolytic enzymes in the rumen of cattle fed crab meal were reported to be too diluted to affect chitin breakdown in cattle that were fed diets containing adequate energy from barley or bromegrass (Husby and Morrow, 1988). However, these workers agreed with White (1981) that chitin-utilizing microorganisms were inducible and that crab meal may be more efficiently utilized in marginally adequate diets such as those with low-quality roughages. This study would confirm that crab shell is poorly utilized in high concentrate diets. Rumen pH was lower in steers fed the crab shell diets and would indicate that the fiber of crab shell had limited buffering capacity to neutralize the acids formed by starch degradation. The lack of buffering capacity may have been due to a low rumen solubility of crab shell or that the lower pH associated with high concentrate rations did not favor microorganisms that would degrade the crab shell. Regardless of the reason for the poor growth performance and lack of buffering capacity, crab shell should not be considered an effective roughage in hulless barley diets and further studies should be conducted to determine crab shell degradation in roughage diets.

Trial II: Steers fed a diet containing 85 percent hulless (Thual) barley had equal ($P>.05$) daily gains and feed efficiency to a diet containing corn-soybean meal as the concentrate. Growth and feed performance of these Hereford steers is similar to performance expected of British breeds of cattle raised at other locations in North America. Daily feed consumption was slightly lower for barley fed steers but the feed conversion was slightly improved with hulless barley over corn as the main dietary energy source. This trial should be considered preliminary and will be replicated in 1989-90 with an additional three steers per diet treatment. If the results of the replicate are similar, Thual barley may prove to be the energy source of choice in cattle finishing diets due to enhanced efficiency when compared to imported corn.

Barley contains a soluble fiber fraction called beta-glucans and this fraction may be related to reduced feed performance for poultry and swine (Bell et al., 1988; Classen et al., 1985; Husby, 1987b; Husby, 1989; Thacker et al., 1987). When Thual replaced covered barley in high performance sled dog diets, fecal water content increased by approximately 10 percent but the diet dry matter digestibility was improved by the addition of Thual (Husby, 1986).

Table 1. Percentage compostion of diets in steer feeding Trials I and II *

	Trial I		Trial II	
Item	Crab shell	Bromegrass	Thual	Corn
Barley, thual	84.5	83.5	83.7	—
Brome grass	—	15.0	15.0	15.0
Corn	—	—	—	78.65
Crab shell	15.0	—	—	—
Soybean meal	—	—	—	5.05
Limestone	—	1.0	1.0	1.0
TM salt	0.5	0.5	0.3	0.3
Calculated analyses				
Dry matter	89.8	89.6	88.2	88.2
Crude protein	15.9	12.1	12.1	12.1
Calcium	1.8	0.45	0.62	0.48
Phosphorus	0.56	0.29	0.29	0.34
ME, Mcal/lb	1.3	1.3	1.3	1.4

* DM basis. Vitamins A and D were injectable at 1 million IU and 150,000 IU respectively, per steer at start of trials. The crab shell diet (Trial I) contains protein in the form of nitrogen bound to the chitin molecule. Approximately 30 percent of the crude protein of crab shell is in this unavailable form and therefore, the true available protein would be approximately 14 percent CP.

Table 2. Growth and feed performance of steers fed Thual (hulless) barley diets with bromegrass or crab shell as a roughage source (Trial I) and Thual vs. corn as an energy source (Trial II).

	Trial I		Trial II	
Item	Crab shell	Bromegrass	Thual	Corn
No.	5	5	3	3
Final wt., lb.	1162	1306	1096	1065
Initial wt., lb.	899	933	715	693
Gain, lb.	263	373	381	372
Days on feed	122	121	125	129
ADG, lb./day	2.14[a]	3.09[b]	3.05	2.88
Feed consumption (lb. feed/hd/day)	16.34[a]	19.86[b]	18.86	19.76
Feed efficiency (lb. feed/lb. gain)	7.63[a]	6.42[b]	6.18	6.85
Rumen pH	5.2	5.8	—	—

[a,b] Values in a row within Trial not having a common superscript differ ($P<.05$).

A recent report by Engstrom et al. (1989) indicated that beta-glucans in covered Canadian barleys may reduce feed conversion by steers. However, Thual barley has a beta-glucan content similar to the Canadian barleys (Husby and Ullrich, unpublished data) and apparently, the rate and efficiency of gains were not affected, since they were similar to the corn diet in this study. Additional research is required to fully evaluate hulless barley as a ruminant feedstuff in Alaska but it may have the potential to replace imported corn as the main energy source in commercial dairy cattle diets now in use in Alaska.

Conclusions

Steers fed hulless barley-bromegrass diets had acceptable growth and feed performance. Thual barley compares favorably to corn as the sole grain source in beef cattle finishing diets and could provide an economical replacement for imported corn in similar feeding situations. Steers fed diets containing crab shell did not have acceptable growth and feed performance. In addition, the lower pH of rumen fluid from steers fed the crab shell diet would indicate that crab shell may not provide the buffering capacity of roughage and therefore may not be an adequate roughage replacement in high-concentrate finishing diets. ❑

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A Class Project in Information Transfer: An Effective Application of Learning by Doing

Carla A. Kirts *

Educators applaud learning by doing as a fundamental teaching strategy which can be used to apply commonly accepted learning principles. Class projects provide a specific opportunity to promote learning by doing.

Learning by doing is potentially applicable at every instructional level, but, in university courses, it is usually neglected in favor of the traditional lecture. Ebel (1988) insists that college-level faculty must become more creative in teaching. Likewise, Ebel challenges professors to become more directly involved in the teaching process so that—even when the lecture method is used—professors actively pursue two-way communication with their students. Class projects offer an excellent opportunity for two-way communication through learning by doing. The learning by doing strategy enhances creativity and active, two-way communication between faculty and students.

One course taught at the School of Agriculture and Land Resources Management, University of Alaska Fairbanks (UAF), ALR 220—Elements of Information Transfer for Natural Resources Managers, offers an excellent example of how a class project can be used to apply learning by doing. During the 1989 spring semester, ALR 220 students conducted an open house for the Bureau of Land Management/Alaska Fire Service (BLM/AFS). Every type of evaluation—students, BLM/AFS employees, and the instructor—substantiated that the open house provided a successful, effective teaching/learning process.

The 1989 Class Project

First the nine students enrolled in the class developed three acceptable proposals for their class project. After thorough analysis, they decided to conduct the open house for AFS, which had just moved into new facilities and wanted to promote its new location and its wild land fire fighting role. The project contained two components: 1) design and install a permanent display for the new facility's main entrance foyer and 2) plan, conduct and evaluate an open house.

By the fourth week of class, the project was well under way. Instruction up to this time included topics such as the role of communication in natural resources management, individual and group communication strategies, and principles of public relations. These and other topics provided some basic concepts and techniques which students applied to the project. Instruction during the remainder of the course responded to students' specific needs as they addressed the various tasks required to successfully complete the project. These topics ranged from writing a memo (professionally communicating with the AFS director) and facilitating handicapped access, to publicizing the event. During this last part of the class, the instructor stepped out of the traditional teacher role and became a facilitator of information and resources rather than the conveyor of knowledge.

Completing the project provided learning opportunities almost impossible to offer in a typical classroom setting. To successfully host the open house, ALR 220 students needed to: designate leaders; divide labor; understand and work within the BLM bureaucracy; recognize and follow protocol; plan specific objectives; assign appropriate time lines for completion; obtain resources—fiscal, physical, and informational; design and install static displays; *interiorscape* (interior "landscaping"); provide for public safety, especially for disabled visitors; coordinate event logistics; publicize the

Dennis Jennings directs Buffie Wilson and Beth Jenkins as the students prepare for the Alaska Fire Service open house. Photo by Jimmy Ellison.

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event; and, when completed, evaluate the event's successes and failures.

For ALR 220, the real world provided a realistic, dynamic and meaningful learning environment.

The Instructional Value of the Project

The project's instructional value was determined using several sources of information. Numerical ratings were available from the evaluations completed by students and BLM/AFS employees. The instructor's evaluation, based on professional judgment and knowledge of various teaching/learning practices, provided general indicators of the project's success.

Evaluation statement *	Mean**
Section I—To provide a general evaluation	
The course as a whole was:	4.50
The course content was:	4.13
The instructor's contribution to the course was:	5.00
The instructor's effectiveness in teaching the subject matter was:	4.63
Section II—To provide feedback to the instructor	
Opportunity for practicing what was learned was:	4.88
Sequential development of skills was:	4.00
Explanations of underlying rationales for new techniques or skills were:	4.17
Demonstrations of expected skills were:	4.38
Instructor's confidence in student's ability was:	4.50
Instructor's enhancement of student interest in the material was:	4.50
Student confidence in instructor's knowledge was:	4.88
Freedom allowed students to develop own skills and ideas was:	4.88
Instructor's ability to deal with student difficulties was:	4.50
Tailoring of instruction to varying student skill levels was:	4.50
Availability of extra help when needed was:	4.75
Section III—To provide information to other students	
Use of class time was:	4.00
Instructor's interest in whether students learned was:	4.88
Amount you learned in this course was:	4.13
Relevance and usefulness of course content is:	4.63
Evaluative and grading techniques (tests, papers, projects etc.) were:	4.13
Reasonableness of assigned work was:	4.13
Clarity of student responsibilities and requirements was:	3.88

* N = 8.

** On a 5 point scale: excellent = 5, very good = 4, good = 3, fair = 2, poor = 1, very poor = 0.

Table 1. *Means for course evaluation statements on the university instructional assessment instrument completed by ALR 220 students.*

Student course evaluations are presented in Table 1. Since the project was the dominant feature of the course, it is reasonable to assume that these evaluations are, in essence, evaluations of the project. On a Likert scale from very poor equaling 0 points, to excellent equaling 5 points, students rated ALR 220 very good to excellent in all cases except "clarity of student responsibilities and requirements." This lower score of 3.88 may reflect students' initial lack of confidence in their ability to successfully complete an open house. At times, the project seemed overwhelming to them. However, after completing it, they were "surprised at how much we accomplished and learned" and "glad for having had the opportunity to experience the real world for a change." On the other hand, this lower score should be a flag to the instructor that effectively communicating course expectations to students is critical.

The BLM employee evaluations of the open house are presented in Table 2. The instrument was designed by the students. Note the creativity they used to label the Likert scale described at the end of Table 2. All general evaluation statements received a mean above 4.0. All 12 respondents indicated that the open house should be repeated. It appears that BLM employees considered the open house a success. Six of the eight open-ended, written comments praised the class. Respondents wrote:

— "I have never seen a better job done by a group such as this. Good planning, high enthusiasm, and excellent execution."

— "The open house gave the public an opportunity to see what AFS does as well as AFS employees and families to see what other areas do."

— "Large turn-out and an excellent opportunity for AFS to expound on what it is we do. People seemed genuinely interested and impressed."

— "This was great for letting the public know what we do."

Negative comments addressed relatively minor points. One comment asked whether the organizational relationship between BLM and AFS was accurately represented. (BLM is the parent agency of AFS just as the U.S. Department of Interior is the parent agency of BLM.) Since the agency's internal rapport and cooperation extended beyond students' control, this comment is somewhat irrelevant with respect to evaluation of the event's success. A more valid comment suggested that the fire fighter portrayed in the televised videotape should have been a real AFS employee, not a student, even though the student did an excellent job.

After the open house the AFS manager wrote that he felt the program was a "smashing success." He continued:

> "This was my first experience with a government project being organized and implemented by a university class. It is a great innovation; and from my standpoint it was much more effective than trying to do it with the AFS staff. We simply do not have the skills and experience to put such an event together as well as your class did." (Owen, 1989)

Students planned an evaluation by public participants; however, the Federal Report Act (Fazio and Gilbert, 1986) prohibits unnecessary solicitation of public opinion. The lengthy and detailed process of applying for special permission to perform such research was considered inappropriate and excessive in this case. Therefore, data representing the public's response to the open house was not available except from informal comments. Most students said public participants made numerous positive remarks to them during the open house.

Evaluation Statement *	Mean**
Section I—general evaluation	
Success of the open house was:	4.45
Overall impact and organization of the students from UAF was:	4.78
Extent to which the open house enhanced the public's attitude toward BLM/AFS was:	4.25
Effectiveness of the permanent lobby display is:	4.50
Section II—Publicity	
Which of the following publicity efforts did you see or hear? (check all that apply)	
Publicity effort	Frequency
TV public service announcements	7
Radio public service announcements	3
School public address system announcements	0
Posters	2
Personal letter to employees	1
Staff meeting	7
Word-of-mouth	12
Other—please specify	3
Section III—Repetition of the event	
Should the open house, or similar event, be done again?	
Response choices	Frequency
Yes, and I would participate	11
Yes, but I would not participate	1
No	0

* N = 12.

** On a 5 point scale: blazing crown fire (best) = 5; torching fire = 4; running fire = 3; creeping fire = 2; smoldering fire = 1; dead out, no fire (worst) = 0.

Table 2. *Summary of the open house evaluation scored by BLM employees.*

The instructor believes the class project supported every course objective. The project significantly applied several important learning principles, including the principle of effect (Crunkilton and Krebs, 1982). This principle states that if students are satisfied with a learning activity, it tends to promote learning. According to the course evaluations, ALR 220 students were satisfied with the class project and felt that it was a valuable learning experience.

Successful application of the principle of effect depends on the instructor's ability to recognize the satisfying/annoying (positive/negative) aspects of the teaching/learning process (Crunkilton and Krebs, 1982) which play significant roles in how the particular instructional method is received by students. In the instructor's opinion, the 12 satisfying learning aspects (listed in sidebar 2) were evident in the open house project; however, several of them did not occur automatically. The instructor needed to actively facilitate approval, recognition, success, confidence, excellence, and security throughout the course.

Perhaps confidence and security were the most important. With a major project, it is easy for inexperienced students to be, or at least feel, overwhelmed. This was countered in this case by helping the students divide complex tasks into subtasks which could be approached systematically. Once students experienced small successes at the beginning, they gained confidence and security which positively affected later, and sometimes more difficult, steps.

On several occasions, students felt overloaded—not enough time to get all the assignments done according to the project's time line. In this case, the instructor suggested a redistribution of the workload. However, as the project progressed and the students gained experience in working together and understanding one another's strengths and weaknesses, they controlled these types of problems themselves.

The project also applied the principle of practice (Crunkilton and Krebs, 1982). A student learns what is practiced. Closely related concepts suggest that an individual learns not only through personal experiences, but also, from others. The open house provided an opportunity for students to apply what they learned in the classroom. The cooperative nature of the project also

Sidebar 1

The Course: ALR 220 is a sophomore level, three credit, elective course. It introduces the information transfer process used by natural resources management professionals. A relatively new course, ALR 220 has been offered four times with enrollments ranging from six to 12. Previous projects were: individual student demonstrations of specific communication techniques, marketing and networking consultation for a new university student organization seeking to establish itself as a cross-cultural link between the campus and rural communities, and a public workshop describing the function and services of the Cooperative Extension Service.

Upon completion of the course, students are expected to be able to:

1. appreciate and understand the significant role information transfer plays in modern natural resources management;
2. define public relations and describe the concept and characteristics of "good/successful" public relations;
3. describe information transfer processes and identify techniques fostering effective transfer with the public and other natural resource managers;
4. list, discuss and give examples for each of the seven principles of public relations as applied to natural resources management;
5. identify the various publics involved in natural resources management and describe information transfer approaches appropriate for each case;
6. describe and apply various information transfer techniques used to accomplish specific goals of communication;
7. describe and apply interpersonal communication techniques;
8. describe, practice, and apply various media-oriented communication techniques in both real and hypothetical situations in a natural resources management context;
9. apply the process of developing a systematic approach (planning) to information transfer;
10. analyze examples of historical and current information transfer and dissemination programs applied in natural resources management; and
11. prepare and conduct a demonstration which deals with some aspect of information transfer in a natural resources management context.

The required text is *Public Relations and Communications for Natural Resources Managers* by James R. Fazio and Douglas Gilbert (1986). The first two sections of the text, "An Introduction to Public Relations" and "The Tools of Public Relations," dominate the first four weeks of the course. The last two sections, "Media and Techniques for Better Communications" and "Some Special Considerations," become resources for the students to use as they proceed through their project. Therefore, instead of systematically studying various forms and modes of communication when the instructor says it is time to, the elements of the project dictate the time and extent to which various communication strategies are taught. This approach uses the principles of timeliness and readiness (Phipps and Osborne, 1988), which infer that, what is learned is most apt to be useful and remembered if it is learned just before it is to be used by the learner.

The final class project represents 40 percent of the final grade. The other 60 percent is based on quizzes, attendance and participation, and assignments. Peer evaluations, self evaluations, and the instructor's evaluation of individual performance determine each individual's project grade. Since the required class project is specifically designed to compliment course objectives, the project evaluation by the class replaces the final exam.

Sidebar 2

Research by Crunkilton and Krebs (1982) has identified at least 12 satisfying/annoying aspects of the teaching/learning process:

1. approval/disapproval,
2. recognition/neglect,
3. success/failure,
4. ownership/non-ownership,
5. confidence/fear,
6. creativity/dullness,
7. excellence/incompetence,
8. service to others/self-centeredness,
9. security/insecurity,
10. freedom/restraint,
11. zest/boredom, and
12. activity/inactivity.

Ideally, an instructor should provide as many positive aspects of the teaching/learning process as possible.

Smoke jumpers demonstrate their skills during the open house. Photo by Jimmy Ellison.

encouraged learning from others including classmates, BLM/AFS employees, and the instructor.

Student-centered instructional approaches are usually preferable to teacher-centered/dominated approaches. According to Phipps and Osborne (1988) discovery teaching is an excellent example. It is a student-centered approach which actively involves students in "identifying problems, gathering data, forming solutions, and developing conclusions." All of these processes occurred during this class project.

Crunkilton and Krebs (1982) specify that the likelihood of teaching success is increased if students participate in planning the learning activities. Phipps and Osborne (1988) consider democracy to be desirable. Both participation and democracy were used in ALR 220 ; students sought and selected their own project.

Not only students benefitted from participating in the class project; the instructor also learned. She gained more knowledge and experience in the art of facilitating instruction. Also, BLM/AFS employees had an opportunity to learn information transfer concepts and skills by watching and assisting the students. As a fringe benefit, these employees now know more about UAF's natural resources management degree program. This knowledge has obvious advantages if one of them wanted to seek a degree. The potential of creating internships and other instructional situations within BLM was probably increased. A link between the academic and the working world has been established.

Conclusions

Evaluating instruction is difficult. In most cases, the sample population is captive, or non-random, and small in number. Therefore, opportunities for controlled experimental research producing reliable and valid empirical evidence are scarce. However, this does not mean course evaluations are impossible, nor should evaluations be neglected. Careful analysis of student evaluations in light of the instructor's perception of the teaching/learning process is productive and can provide valuable insight into the general effectiveness of instruction.

In this case, the class project was specifically used to promote learning by doing. Students enjoyed the experience, completed a successful project, and reported that they learned a lot about information transfer and how it is applied in a government agency. BLM/AFS employees, including the AFS manager, deemed the project a success and praised extending the classroom into the real world. They plan to repeat the open house. The instructor noted that several significant teaching/learning principles were applied and recognized that facilitating instruction effectively was a key to using the class project method successfully. Systematic guidance and continuous feedback for students may be the difference between success and failure.

The class project will continue to be a standard requirement in ALR 220 as long as class size is not prohibitive. The project has been, and can continue to be, an effective method of promoting learning by doing. ❑

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Alaskan Food Costs: Do We Really Pay More for a Nutritionally Balanced Diet ?

Ruthann B. Swanson,* Marguerite A. Stetson,** Carol E. Lewis,*** and Cathy A. Birklid ****

How expensive is it to purchase foods for a nutritionally balanced diet in Alaska? The Alaskan cost of living, including cost of food, is reported to be higher than in most other areas of the United States. Adjustment for the cost of food has been an important bargaining item in labor contracts, cost of living allowances, divorce settlements, and food stamp allotments (Stetson, 1985a). Without these income adjustments, many Alaskans might find it difficult to meet their basic nutritional needs. This is particularly true at lower income levels (Peterkin et al., 1982), because costs influence type of foods purchased and ultimately dietary quality.

Many consumers wonder just what each dollar spent on food is actually buying. The portion of one dollar spent in each step from farm to home is depicted in Figure 1; this U.S. average includes Alaska. The perceived higher costs found in Alaskan supermarkets have been attributed to higher transportation costs because of shipping distance and a smaller market thus lower volumes shipped, as well as, less wholesale/retail competition (Thomas, 1976).

The U.S. Department of Agriculture (USDA) has developed family food plans to serve as purchasing guides for a nutritionally balanced diet at four different cost levels (Cleveland et al., 1983a). These guides, known as the thrifty-, low-, moderate- and liberal-cost family food plans, are based on the National Food Consumption Survey and the Recommended Dietary Allowances. Appropriate quantities of a variety of foods are identified so that nutritional needs can be met without disrupting the typical American family's eating patterns. Many foods are common to all four food plans, although the purchase amounts suggested may vary (Cleveland et al., 1983b).

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A family food plan similar to the low-cost USDA plan, the base-cost plan, was developed for Alaska. There were 105 food items included. This food plan was designed to reflect foods available not only in urban centers but also in rural areas remote from these centers where the variety of foods available can be limited. Costs to urban Alaskans and residents of five west coast cities for a month's supply of food products providing a base-cost nutritionally balanced diet (Stetson, 1985b) were compared in this study. A 1977-78 study showed that the majority of urban Alaskans consume foods that are more typical of the moderate- and liberal-cost USDA family food plans (USDA, 1981a,b). It is doubtful that this pattern has changed. The costs of typical breakfast and dinner meals were calculated using the Alaska base-cost food plan as a guide. Using these meal plans, food prices in the eight cities studied were compared.

Methods

Prices for food items were collected in September 1988 in five west coast cities (Los Angeles, Portland, Reno, San Diego, Seattle) and three major Alaskan urban centers (Anchorage, Fairbanks, Juneau). Surveyors were trained to ensure consistency in collecting prices. In each community, the food items were priced in high volume supermarkets located in neighborhoods which were

Urban Alaskan consumers find their supermarkets offer selections equal to that of other major west coast cities. But Alaskans find higher prices as a part of living in Alaska.

demographically similar. Supermarkets surveyed were major chains. In all cases, prices were collected on the item with the lowest price per unit regardless of brand or package size. This procedure was necessary because different brands and package sizes were available in different communities.

The 105 food items surveyed represented all of the basic food groups and included processed food items. Quantities used to calculate the cost of purchasing foods for a month were appropriate for a family with two adults and two elementary school aged children. Adequate food to prepare breakfast, lunch, dinner, and snacks at home were priced. This procedure allowed the cost of the total diet rather than only individual food items and/or individual meals to be compared.

Results and Discussion

Monthly Food Costs for a Family of Four: Monthly grocery costs for a family of four, based on the Alaska plan, are depicted in Figure 2. Variation in the total costs among the west coast cities was small. San Diego consumers had the highest and Portland residents the smallest grocery bill. The average cost was $313.20 per month.

Alaskan consumers in all three cities had higher grocery bills than did west coast consumers. In Anchorage, bills were 26% higher than the west coast average, while Fairbanks consumers paid additional 31% compared to the west coast. Juneau grocery bills were 24% higher.

Although total costs were greater in Alaska, these higher costs were not due to one or two food groups (Table 1). Total cost difference was distributed across all food groups. Within a food group, fresh products were slightly more expensive in Alaska than were canned, frozen or dried products. On the west coast, costs of fresh and preserved products were approximately equal. This breakdown has implications for future food costs as consumers are more and more frequently choosing the fresh product over its preserved counterpart when available (Jackson, 1987). If Alaskans follow this national purchasing trend, the cost disparity may further increase.

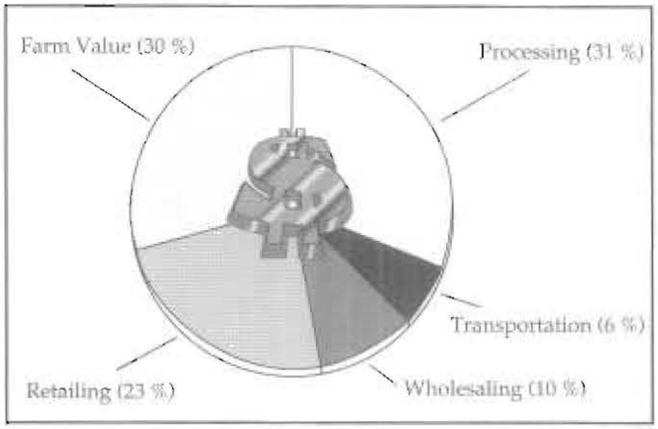

Figure 1. Where the dollar goes for food consumed at home. (source: USDA, 1989.)

The costs reported for the family of four in figure 2 represent only the dollars spent on food items. Consumers often spend more than reported here at the grocery store. Today's supermarkets frequently sell everything from food to cosmetics and many consumers purchase a large number of non-grocery items such as paper products, detergents and even toys during a trip to the grocery store. These items may constitute a considerable portion of the typical consumer's monthly "grocery bill."

Food costs may also be higher if the base-cost family food plan is not used. Consumers who frequently

Table 1. Cost of 105 foods items required for a nutritionally balanced diet for a family of four** for a month.*

City	Total Cost $	Percentage spent on each food group: Flour/ Cereals	Meat/ Alternatives#	Milk/ Products	Fruits/ Vegetables	Sweets/ Fats	Beverages
Anchorage	394.43	20.5	32.0	15.6	23.1	4.3	4.5
Fairbanks	410.73	21.5	31.7	15.9	22.0	4.1	4.8
Juneau	387.52	19.5	34.4	15.6	22.3	4.4	3.9
Seattle	317.14	19.4	36.6	13.9	21.9	4.8	3.4
Portland	303.89	21.8	35.3	12.7	21.7	4.3	4.1
Reno	313.30	17.3	39.5	14.7	19.7	4.6	4.3
Los Angeles	306.36	20.0	37.2	14.3	20.5	4.5	3.6
San Diego	325.29	20.5	39.9	12.7	18.7	4.2	4.0

* Based on USDA "low-cost" meal plan
** Two adults and two elementary school age children
\# Beans, eggs, etc.

choose more expensive cuts of meats such as New York strip steaks or fresh seafood, fresh or frozen rather than canned fruits and vegetables, frozen, prepared entrees, or items from the in-store deli, bakery, or salad bar, will have a higher food bill. Even when foods similar to those on the survey lists are purchased but in different sized packages (usually smaller), or a more expensive brand name is selected, increased costs will be reflected in the grocery bill. Today's U.S. consumers are more and more frequently choosing branded products for both fresh and preserved items. This trend has occurred as quality has become increasingly important in food selection (McNutt, 1988).

It is not an easy task to provide the nutrients which meet the Recommended Dietary Allowances for a family of four and remain within the budget for the USDA low-cost family meal plan or the base-cost Alaska food plan. Awareness of nutritional content of foods is necessary. Shopping skills, food preparation skills, time to prepare food items, and adequate food preparation facilities are also essential (Davis, 1982; McKenzie, 1974).

It is much easier to meet nutritional needs of family members if more money is available to spend on food or there is a greater variety of products from which to choose. However, increasing money available or variety does not guarantee that the nutritional quality of the diet will be improved. Factors such as food preferences, habits, socio-cultural background, demographics, and prestige may override nutritional considerations (Davis, 1982; McKenzie, 1974).

Breakfast and Dinner for a Family of Four: Hypothetical breakfast and dinner meals which represent food choices at higher cost levels, as well as those in the Alaska base-cost category, (Kinder, 1973) are found in Table 2. A hypothetical lunch was omitted from these menus because most people in the U.S. consume at least one meal a day away from home, most frequently lunch (USDA, 1989). Snacks were also excluded. Although the meals priced are typical of the three family meal plans, costs at different locations may vary greatly because only a single meal was priced. This effect could have been enhanced because prices were obtained on only one day when sales or promotions may have influenced the cost of menu items. Therefore, these food costs should be used only as an indication of the relative costs of each family meal plan.

Breakfast: Foods to prepare the base-cost breakfast could be purchased in all the west coast cities for $1.60 or less. San Diego had the highest costs ($1.57) while Seattle and Portland residents enjoyed the lowest cost breakfast ($1.17). In Alaska, costs were higher in all three urban centers. Juneau residents paid 30% more than the west coast average cost of $1.36. Anchorage consumers spent 35% more and Fairbanks residents found the same breakfast items cost an additional 45% (Figure 3).

The moderate-cost breakfast (Table 2) could be prepared for a family of four for an average of $2.59 on the west coast. Costs in Alaska averaged 29% higher. Once again, Fairbanks residents paid more than their fellow Alaskans. The prices paid by these interior Alaska consumers were 37% higher than the average on the west coast (Figure 3).

Cost of the foods needed to prepare the liberal-cost breakfast (Table 2) ranged from a low of $3.51 in

Family Food plan	Meal: Breakfast	Meal: Dinner
Low-cost	Apple Juice Eggs Toast Jam Coffee Milk	Chili with Beans Saltines Carrot Sticks Celery Sticks Cookie Coffee Milk
Moderate-cost	Orange Juice Bacon Eggs Toast Jam Coffee Milk	Pork Chops Potatoes Green Beans Applesauce Bread Margarine Cake Coffee Milk
Liberal-cost	Grapefruit Halves Ready-to-Eat Cereal Coffee Cake Coffee Milk	T-bone Steak Buttered Potatoes Tossed Salad Dressing Whole-Grain Bread Butter Cantaloupe Coffee Milk

Table 2. Meals typical of the USDA family food plans at three cost levels.

Portland to a high of $5.94 in Anchorage. The average Alaskan costs were 47% higher than the average west coast costs (Figure 3).

When the relationships between the breakfast menus were examined, the moderate-cost breakfast over the base-cost breakfast cost west coast consumers 90% more. Alaskans who made a similar choice experienced a 79% increase. Selection of the liberal-cost breakfast increased Alaskan consumers bill by 210%. West coast consumers had a 187% increase in the prices paid when compared to the base-cost breakfast.

Dinner: Foods to prepare a base-cost dinner (Table 2) for a family of four at home could be purchased for as little as $2.46 in Seattle; west coast costs averaged $2.54. Average Alaskan costs were 20% higher, with Fairbanks experiencing the highest cost among the urban Alaskan cities. The relationship among the cities studied was similar to that for the monthly grocery bill (Figure 2) when compared to the cost of the dinner meal (Figure 4) for the base-cost family plan.

Overall, the cost to prepare the moderate-cost meal (Table 2), was 23% higher in Alaska than on the west coast. However, the percentage difference varied greatly among the cities surveyed. Although the cost tended to be lower in some west coast cities such as Reno, in San Diego the costs were essentially the same as those in Fairbanks and Juneau (Figure 4). Anchorage consumers paid the highest costs.

Cost of foods to prepare the liberal-cost dinner also varied widely depending on location, with a 27% spread among the west coast cities surveyed. Alaskan costs were 30% higher than the west coast average. Fairbanks consumers paid more than did their Anchorage and Juneau counterparts (Figure 4).

The cost relationship among the family food plans for these dinner menus as budgets became more liberal showed a greater percentage increase in Alaska than was found on the west coast. Whereas a 97% increase was found when west coast consumers selected the moderate-cost meal over the base-cost meal, Alaskan consumers who made the same choice spent 102% more. West coast consumers who selected the liberal-cost meal paid 222% more than families who consumed the base-cost alternative. In Alaska, the cost increase was 248% higher.

Conclusions

Food purchased in Alaska on the base-cost family food plan resulted in a 24% to 31% higher monthly grocery bill than the same low-cost items on the west coast. When food groups (fruits and vegetables, dairy products, meat and meat alternatives, sweets, fats and oils, bread and cereal products) were compared, cost

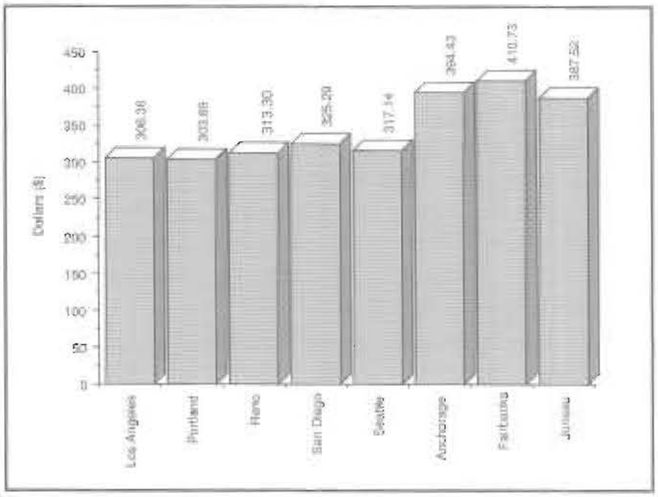

Figure 2. *Total monthly food cost for family of four, September 1988*

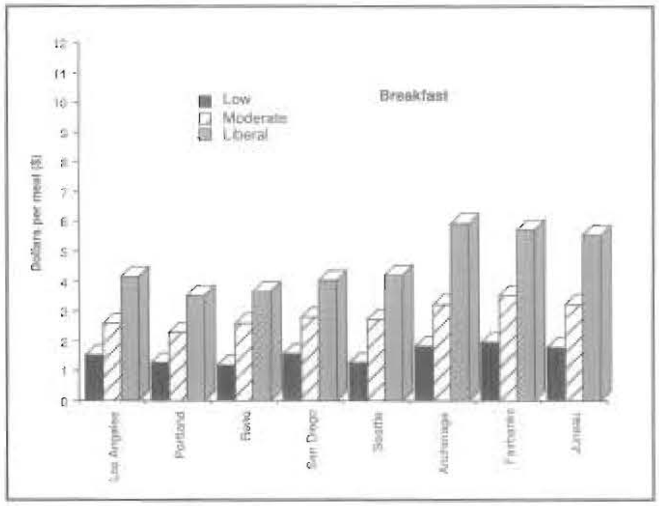

Figure 3. *Breakfast — Low, moderate and liberal food costs, September 1988 for family of four.*

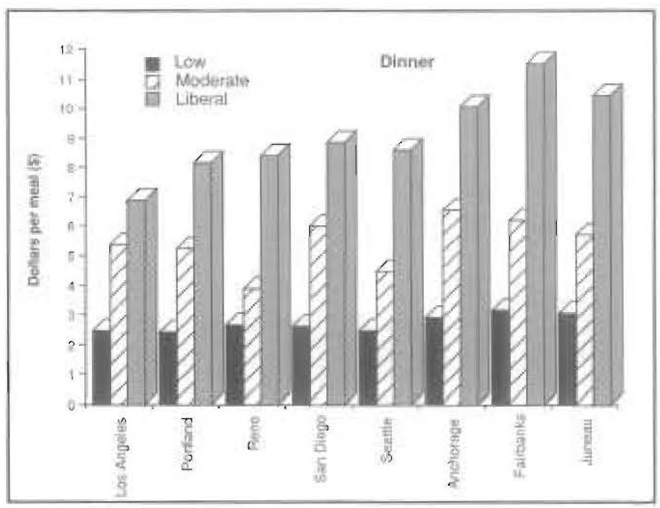

Figure 4. *Dinner — Low, moderate and liberal food costs, September 1988 for family of four.*

differences appeared to be distributed almost equally although there was a trend toward higher cost for fresh items within a food group in Alaska.

The cost difference between the west coast and Alaskan cities was also higher, when cost for meals based on the moderate- and liberal-cost family food plans, more typical of the eating patterns of urban Alaskans, were compared. However, other factors including specific cities and current consumer purchasing trends are likely to impact these grocery bills.

Food costs presented here represent only a one-time view of the costs of a limited number of food items in specific locations. Surveys over a longer period of time are needed to verify trends observed among the family food plans considered here. Expansion of the number of locations in Alaska would also be helpful in illustrating state wide cost patterns for the same family plans and food groups. ❑

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Permit Reform in Alaska's Coastal Zone

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During the 1970s the number of proposals for development and the number of federal and state permits required for development increased dramatically in Alaska. The large number of projects and permits overloaded agencies (Environmental Protection Agency 1982). Permit applicants complained about delays and conflicting directives from agencies (Mueller, 1983).

Two factors aggravated the problem in the coastal zone. First, many oil industry projects, as well as public works projects funded by oil revenues, were proposed in the coastal zone. And second, coastal resources and coastal communities were given special status by the Alaska Coastal Management Act (ACMA) of 1977. The ACMA established broad goals for protection of coastal resources and established 33 coastal districts (Figure 1) to implement coastal management plans. Once a coastal plan was completed and approved, the district assumed the right to review projects within its boundary that required state or federal permits.

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The coastal district review was important. State and federal agencies could not issue a permit until a project was found consistent with the coastal plan. Under state code, however, the state agency that issued a permit, after consultation with the coastal district, wrote the consistency review. Often districts and agencies did not agree on whether a project was consistent with the plan. Additional confusion occurred on projects that required permits from more than one state agency. In this situation each agency wrote its own consistency review. When these reviews did not agree, all parties—applicant, coastal districts, and agencies—were frustrated.

In 1984, increasing conflict among the players persuaded Governor Sheffield to establish a new coordination agency, the Division of Governmental Coordination (DGC). That same year, the legislature passed regulations (6 AAC 80, 85) that created a process to streamline permit review in the coastal zone. The DGC was appointed the process manager. Since 1984, the DGC has guided over 2500 projects through the process. This study presents an evaluation of the process by those who have participated most closely in the new process: project applicants, state agency staff, and coastal district staff.

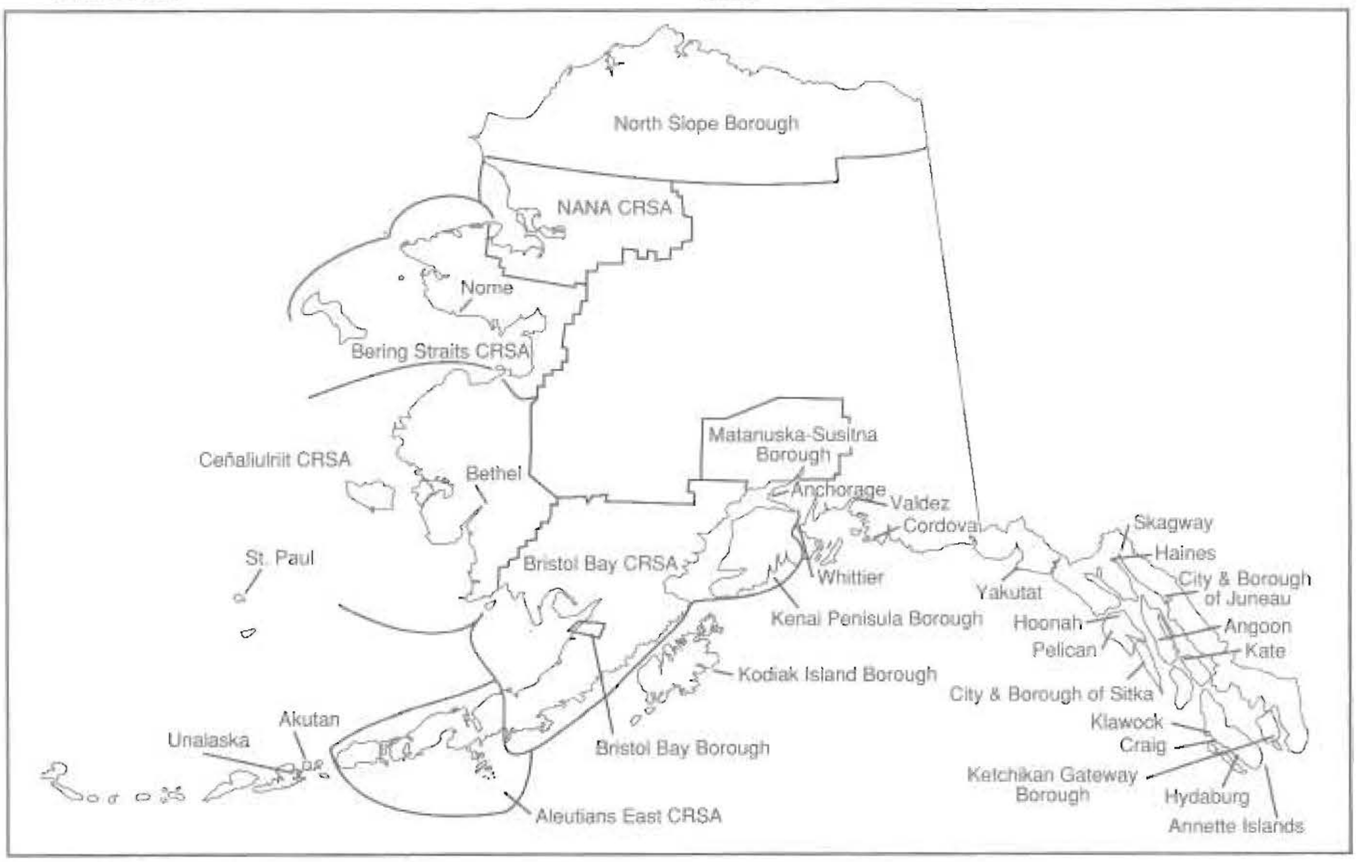

Figure 1. Alaska's coastal zone districts and coastal zone boundaries (approximate).

Consistency Review Process

The new process, called the "consistency review process," coordinates the coastal district review with state and federal permit reviews. Under the new process, when a project requires a permit from more than one state agency, the DGC writes the consistency determination. (For projects that involve only one permit, the permitting agency writes the determination.) The DGC mediates discussion among state agencies so that the state has one position toward a project. The agency also coordinates applicant and agency interaction with federal agencies. The new process does not change the criteria either state or federal agencies use to evaluate projects.

The process provides a timetable for the review and a deadline for state agencies to issue permits (Table 1). State agencies must issue their permit(s) not later than 30 days after an application is submitted, or 50 days if a permit requires a public hearing. Once the DGC issues a positive consistency review, agencies **must** issue their permits within five calendar days. Federal agencies are not obligated to follow these deadlines, but neither they, nor state agencies, may issue permits if the DGC issues a negative determination. If an applicant, the coastal district, or an agency is dissatisfied with the DGC's determination, there is a rapid appeals process to the commissioner level.

DGC plays several key roles in the process. Staff members guide applicants in completing the permit applications and manage the calendar of activities and deadlines. The DGC also serves as the clearinghouse for information flowing between applicants, agencies, and coastal districts. In addition, the agency keeps the primary set of project records.

Application of the process is limited in several ways. It does not apply outside Alaska's coastal zone, the boundary of which is established by each coastal district, as it prepares its coastal management plan. The process also does not apply to mining projects, which go through a separate "tri-agency application" developed specifically for mining. Projects that have a "de minimus" impact or require only a standard condition of approval, as determined by DGC, are given "categorical approval" and do not go through the process.

The DGC has guided about 500 projects through the process each year since 1984. About 100 projects each year have received categorical approval. Of those projects that enter the process, less than 10 percent are withdrawn by the applicant. Although no data is kept on reasons for withdrawal, reasons apparently range from changing business conditions to obvious inability to meet permit criteria. Of those projects that proceed through the process over 99 percent receive a positive determination. This high rate occurs in part because most projects are modified in location, design, construction detail, or operation as they move through the process. The high rate of positive determinations is consistent with that found in other states (Lowry and Eichenberg 1986).

Methods

People interviewed for this study were from three groups: applicants, coastal district staff, and state agency staff. Applicants were classified into four groups: small businesses, large business, local government, and state/federal agencies. Ten applicants were selected from each group. For coastal district staff, 17 of the 33 liaisons to DGC were selected. And for state agency staff, 17 of 32 liaisons to DGC were selected. All selections were random.

Interviews were conducted, in June of 1988, with people associated with the process in the 1987/88 fiscal year. In that fiscal year, 468 projects went through the process. The 74 interviews were conducted by telephone. Each interview involved asking the person to respond to 12 statements and one question. The response scale for statements was: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The statements, in summary form, were:

1. The process coordinates agency permits.
2. The process helps involve local communities.
3. The process helps identify participants' interests.
4. The process helps develop better solutions.
5. The process helps reduce conflict.
6. The process helps applicants receive their federal permits.
7. The process helps save us time and money.
8. The process time-frame is acceptable.
9. DGC staff is knowledgeable and helpful.
10. State permits are issued promptly.
11. Federal permits are issued promptly.
12. Alaska should keep the office/process.

After each response, people were asked to add comments. The interview concluded with the question, "What are the strong points of the process and what would you change?" Responses were evaluated by calculating mean scores for each group and comparing differences in scores and comments, among groups.

Results

Table 2 presents the mean scores for the six groups. For this study, scores between 2.50 and 3.49 are referred to as "neutral." Lower scores are referred to as "disagree" and higher scores are referred to as "agree" (3.50 to 4.49) and "strongly agree" (greater than 4.50).

Statement 1 concerned the primary goal of the permit reform, coordination of agency permits. All groups agreed that the process helps coordination of permits. Large businesses and local governments were particularly strong in their agreement. Comments made following this statement were uniformly positive, such as "without the process, permitting would be a nightmare."

Statement 2 involved a primary goal of the AMCA, involving local communities more effectively in the decision process. All groups agreed with this statement except for state/federal applicants who were neutral. Comments from coastal district staff were very positive, such as "before DGC, we were often left out." Comments made by applicants indicated that they felt communities were able to participate, but perhaps too much, thus increasing the number of changes to a project.

Statement 3 addressed whether the process "helps to identify participants' interests and goals." All groups agreed with this statement. State liaisons had the strongest level of agreement, with one person commenting that the process "helps village people to understand agency policies."

Statement 4, concerning "develops better solutions," received diverse scores. State agency staff agreed that the process produced this value, but small business applicants disagreed. Comments from state agency staff indicated that they thought the process was valuable because it allowed changes to be made in the project. Small business applicants, however, felt that the "new solutions might be more acceptable, yes; but better, no." Many applicants noted the additional cost of changes made during the review process.

Statement 5 focused on whether the process "prevents or resolves conflict." All groups except small business applicants agreed with this statement. Comments indicated that the process itself precipitated some conflict. One state agency staff noted that the process "causes problems and then solves them," and a small business applicant stated that the process "probably solves more problems than it creates."

The value of the state-managed process in helping applicants receive their federal permits was addressed in statement 6. Only applicants were asked to respond to this statement and all agreed, although marginally. The few comments received were positive, including one small business applicant who called the DGC "the only helpful agency."

Statement 7 considered two of the major reasons

STEP	30-day Schedule DAY	50-day Schedule DAY
Pre-application meeting and other early contact.	—	—
"Day one."*	1	1
Applicant submits completed packet; DGC distributes packet and review schedule to resource agencies and coastal districts.	1-2	1-2
Review period.	3-17**	3-34**
Last day to file request for more information through DGC.	15	25
Last day for request for public hearing and last date for verbal comments from agencies (must be followed in writing within 5 days).	17***	34***
DGC prepares "proposed determination," notifies applicant, agencies, and districts.	18-24	35-44
Last day for written statement requesting elevation to director level.	29	49
If a concensus is reached, consistency determination prepared and distributed.	30	50
Latest date for issuance of state permits.	35	55
Time period for elevation (appeal) to director level.	30-45	50-65
Time period for elevation to commissioner level.	45-60	65-80

* "Day One" begins when applications are complete.
** 10-day extension is provided in the "unorganized borough," areas without municipal government.
*** Coordinating agency must decide within 7 days whether to hold a public hearing. If so, the agency must provide 15-30 days of notice and provide summary of hearing 5 days after.

Table 1. *Timeline for Alaska consistency review process.*

for permit coordination, time, and money. All groups, except state agency staff who were neutral, agreed that the process saved them time and money. Comments were generally positive, including "75 percent of applicants are helped, 25 percent are hurt," offered by a state agency staff person. And, "yes, especially time;" and "yes, because DGC projects are seldom litigated" by several large business applicants. Several small business applicants commented that, although the DGC process saved them time and money compared to acquiring permits by themselves, they scored this statement low because any expense for permits was excessive.

Statement 8 raised the question of "the time frame is acceptable." All scores for this statement were neutral, except for coastal district contacts who agreed. Applicants uniformly felt the time line was too long, although one small business applicant noted that the process was "much better than in 1984." Applicants noted that the time frame was too slow given Alaska's short construction season, and that minor and emergency projects were often unnecessarily bound up in the process. A large business applicant commented that Alaska's time frame was irrelevant since federal agencies were so much slower that projects were delayed anyway. Coastal district contacts and state agency staff, on the other hand, often felt that the time frame was too short. Coastal district contacts argued that it was often difficult to "talk around the village" in the short review period. And, state agency staff noted that it was often difficult for them to gather enough information to make a credible decision during the time frame.

Statement 9, concerning the knowledge and helpfulness of the DGC staff, received the highest level of agreement in the study from applicants and coastal district contacts. All applicant groups strongly agreed with this statement. All comments were positive, or positive with a single criticism. This criticism was, particularly from state agency staff, that the DGC staff lacked the technical knowledge they need to fully understand the projects. Still, the consensus of comments was that, without the staff, the "DGC would be just another bureaucracy."

Statements 10 and 11 provided an opportunity for those surveyed to compare the promptness of state and federal agencies in issuing permits. All groups agreed, except small businesses who were neutral, that "state permits are issued promptly." Many applicants commented that the DGC process was still too long, but most added that it was much better than in 1984. All groups were neutral about the statement that "federal permits are issued promptly." A representative comment was, "look at what the feds are doing, or not doing—it's a mess compared to the DGC process." The Corps of Engineers drew the most comments among federal agencies for delays. These comments are consistent with data that shows that state permits take an average of 10 days and federal permits take an average of 60 days following the consistency determination

			Applicant Subgroups				
	State Liasons (n = 17)	District Contacts (n = 17)	Applicants (all) (n = 40)	Small Business (n = 10)	Large Business (n = 10)	Local Government (n = 10)	Federal Agencies (n = 10)
Statements							
1."Coordinates agency permits"	3.94*	3.88*	4.00*	3.55*	4.33*	4.20*	3.90*
2."Involves local communities"	3.94*	3.69*	3.61	3.60	3.66	3.87	3.28
3."Identifies interests and goals"	4.00*	3.86*	3.68*	(a)	3.55	3.80*	3.70*
4."Develops better solutions"	3.70*	3.53	3.05	1.80	3.00	3.40	3.40
5."Prevents or resolves conflict"	3.70*	3.56*	3.72*	3.40	4.00*	3.88*	3.50*
6."Helps applicants receive federal permits"	na	na	3.59	3.80*	3.55	3.50*	3.50
7."Saves time and money (for entity)"	2.94	3.54	3.76	3.28	4.00*	4.14*	3.70
8."Time frame is acceptable"	3.23	3.52	3.05	2.30	3.30	3.30	3.05
9."Staff is knowledgeable and helpful"	3.94*	4.41*	4.47*	4.50*	4.53*	4.50*	4.55*
10."State permits are issued promptly"	3.88*	4.00*	3.67*	3.40	3.62	3.70*	4.00*
11."Federal permits are issued promptly"	2.62	3.25	2.74	2.50	2.88	2.70	2.90
12."Alaska should keep the office/process"	4.18*	4.41*	4.33*	4.10*	4.44*	4.44*	4.40*

Likert-scale used: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

* significant at $p < 0.05$ level.
na not applicable.
(a) insufficient response, less than 6 of 10.

Table 2. *Mean scores for statements by groups and subgroups.*

(Division of Governmental Coordination, 1988).

The last statement, "Alaska should keep the process," generated high scores. All groups agreed with this statement, several with scores near the strongly agree mark. Comments were overwhelmingly positive, even among some business applicants who would rather have no permits (and even no government). At worst, the process was seen as a "necessary evil" or "redundant." At best, it was described as "working very well," "something to fall back on," and "very valuable for private applicants."

The question about "the strong points of the process and what you would change" elicited a variety of responses. District contacts noted the value of the process by involving them early and giving them access to decisions. Several districts argued that the process reduces their need for staff. State liaisons noted the additional value of the process in "designing-out" problems and of providing a forum that generates consensus. Small business applicants enjoyed having a single contact person and found the extra "depository for records" valuable. Large businesses found value in forcing agencies to work with applicants, of resolving agency jurisdictional problems, and of organizing the process so that there were few opportunities for legal challenges based on procedural errors. Local government applicants responded that the process ensures that agencies follow rules and uniformly apply standards. Like the coastal districts, local governments also thought the DGC saved them from hiring additional staff. State and federal agencies recognized the value of DGC staff as mediators and the value of the extra help during rush periods.

District contacts asked for a readable guidebook, less jargon, a rational method for balancing values, training for their staff, extending the public review period, simplifying the process, and provision of extra funds to help them conduct their portion of the review. State liaisons wanted more consideration of other agency time lines, more staff to coordinate with DGC, and federal legislation to force federal agencies to develop a comparable process. Applicants asked that DGC be given more "clout" to control "radicals" (within agencies) and to "push" other agencies to complete their reviews as early as possible. They also asked that the time frames be shortened, that new processes be developed for very short or very large projects, and that there be a better "fit" of the process to Alaska's short construction season.

Conclusions

This study provides an evaluation of the DGC process by people who are directly involved with the process. Those involved found the process to be successful in achieving its primary goals of coordinating permits and involving local communities. The process also produced other benefits, such as savings in time and money, helping applicants receive their federal permits, reducing conflict, and developing better solutions. Participants in the survey also recommended a variety of changes to improve the program.

Perhaps the most important change that could be made in the permit reform movement would be to bring federal agencies into the process. Although applicants receive their state permits rapidly, most projects were delayed by federal permits. The time benefits produced by the state process were lost because of the lack of a comparable federal process. The potential for a joint state-federal review should be studied. For small or common projects that involve little controversy, the state's 30-day process might be appropriate. For very large projects, such as major mines, a more comprehensive process, such as the Colorado Joint Review Process (Gallagher 1987), might serve to bring state and federal agencies together with local government and interest groups interested in such large projects. This study provides ideas about the successes of the process and what might be changed. It also indicates the support the DGC and process receive from its constituency. Among this constituency are many of Alaska's major industries including oil, timber and fishery corporations. Also important are local governments. The process helps local government in two ways, when they apply for permits and when they participate in the coastal district review. The benefits of the process are undefined, but apparently surpass the DGC's $950,000 budget (FY 1987/88).

Alaska's process of permit reform is unique among the coastal states. It appears to be a particularly appropriate process in Alaska where environmental concerns demand strict adherence to permit requirements, and where development concerns—such as the short construction season—demand rapid decisions. This introductory evaluation suggests that the Alaska experiment in permit reform is working. ❑

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