AgroBorealis

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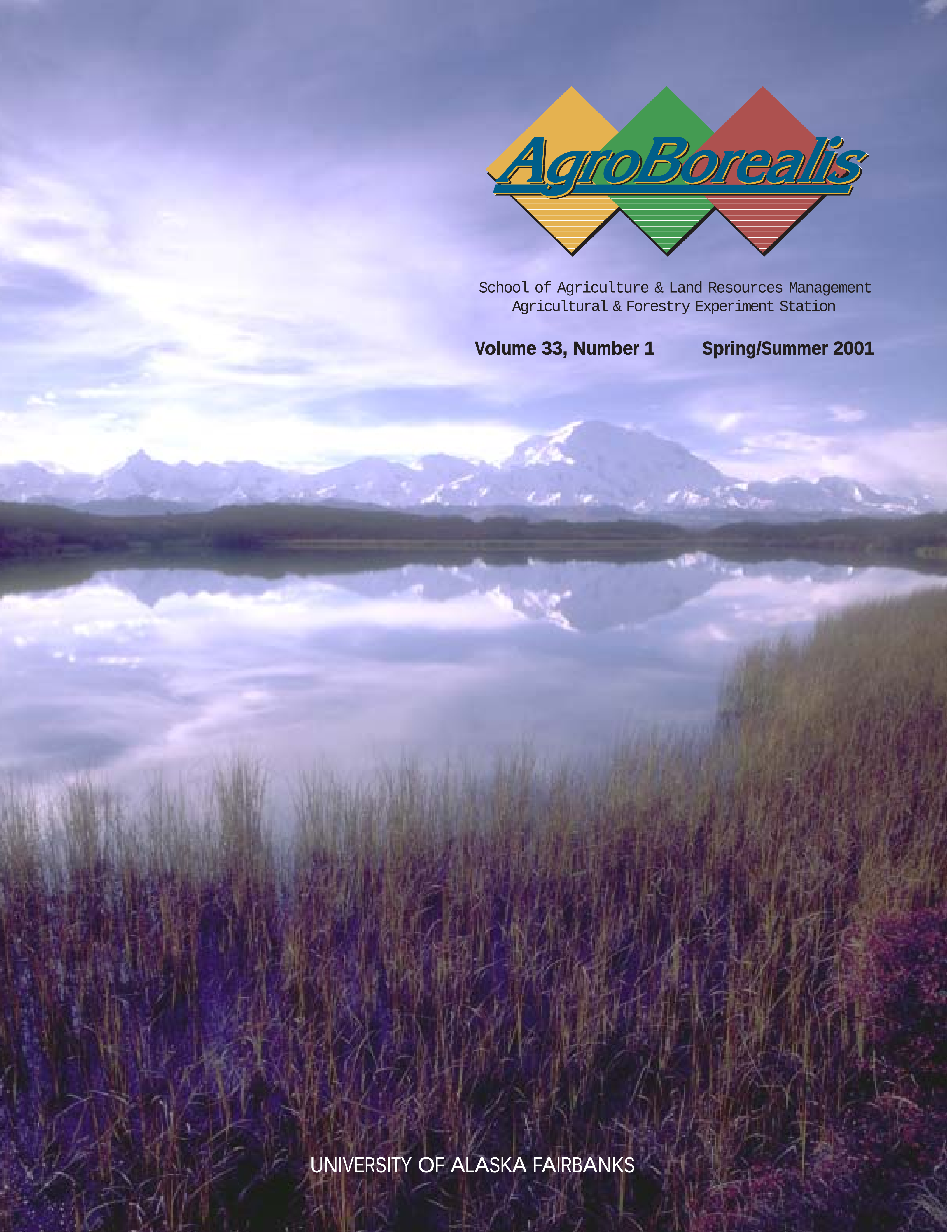

UNIVERSITY OF ALASKA FAIRBANKS

Although it's not hard to feel like agriculture in Alaska is isolated from the rest of the country (or the rest of the world for that matter), sooner or later we're reminded that we're part of a bigger picture.

For me that reminder came when I got together with editors from other western experiment stations, to combine research from several western states into a set of impact papers. The following is excerpted from an impact paper on competitive agriculture. It provides just a few examples of the agricultural research that's being done in Alaska, and in other western states.

It wasn't surprising to find that people were fascinated with the agriculture that takes place in our state—after all, not many people work with reindeer, or experience plants growing under round-the-clock daylight. But what was most gratifying was to see that Alaska's agriculture can be competitive in a bigger arena.

(Note: The impact papers will be available soon on the USDA research and extension website, at www.reeusda.gov/success/impact.htm).

Neal Muirhead
Editor

A Better Bull Market

New markets, new crops and new methods help growers improve their bottom line.

Hailstorms, grasshoppers and drought aren't the only challenges modern agricultural producers face. Stiff competition and fast-paced technology are more important than ever to farmers and ranchers managing their operations. By developing improved crops and methods, and finding new uses for meat and plant byproducts, growers are increasing quality, lowering production costs and expanding into new markets.

Don't take out the trash. Arizona researchers showed meat producers how to earn an additional $40 to $50 per animal by turning normally discarded byproducts into sellable items like pet chews. One new product is a meat log for pets that is half meat and half peas, carrots and other ingredients, and has a long shelf life. In **Alaska**, forestry researchers are developing ways to use leftover tree byproducts from logging to produce ethanol as a fossil fuel alternative. In addition to the environmental benefits, an ethanol processing plant could provide 125 new jobs for rural Alaskans. In **Utah**, researchers are testing wheat mill run, a byproduct of the wheat milling industry, as a viable feed source for cattle.

Knowledge is power. Elaborate information tracking systems help Western livestock producers lower production costs while producing higher-quality meat. Participants in a **Montana State** Beefability program made an average of $93 more per calf by tracking each animal's performance at the feedlot. In **Wyoming**, the Beef Quality Assurance program reduced carcass blemishes by 15 percent. In **Alaska**, researchers tagged free-ranging reindeer and developed a database to track herd information. Herders use laptop computers to access the database and make management decisions that improve operating efficiency and produce higher-quality animals.

Cash crops and cash cows. Arizona researchers have discovered cancer-fighting compounds in native desert plants. **Alaska** researchers on the Muskox Task Force are helping producers enter emerging markets for exotic meats and knitted products from qiviut, the long silky hairs of muskoxen.

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In This Issue

About the cover: Arctic pendant grass *(Arctophila fulva)* along the shore of Wonder Lake, looking toward Denali. This grass is indigenous to Alaska and is common in wet habitats. It is one of the species that Jay McKendrick found growing along in the Alaska Pipeline corridor (see article on page 4).

Back cover: The livestock barn at the Fairbanks Experimental Farm (located at the base of the UAF campus) is one of the few classic red barns in the Fairbanks area. It's proximity to the Georgeson Botanical Garden makes it a popular photo subject for visitors.

All photos in this publication are by the authors or are AFES file photos.

Inventory of Grasses Along the Trans-Alaska Pipeline –1999

• *Jay D. McKendrick*

The Trans-Alaska Pipeline System (TAPS) right-of-way (ROW) permit is soon to expire. In 1999, BP Exploration (Alaska), Inc. recruited a group of individuals to develop documents in preparation for the right-of-way renewal application. The objective was to assemble and synthesize existing information about the ROW. The revegetation topic was my assignment. Examining the revegetation information revealed a series of investigations over about a 10-year period. Route vegetation studies commenced before pipeline construction began and largely ended about three years after oil started flowing through the pipeline. As I can best determine, the sequence of studies was:

1) Dr. William Mitchell conducted a plant ecological survey of the northern section of the proposed route for Alyeska Pipeline Service Company (Mitchell 1970).
2) Alyeska Pipeline Service Company took 15,000 surface soil samples along the proposed route and prepared a fertilizer guide for revegetation based on laboratory tests (Hubbard 1980).
3) Johnson, Quinn and Brown investigated revegetation and erosion control practices at selected locations as the pipeline was being constructed (Johnson and others 1977).

1975-1978: L. Johnson observed revegetation treatments at 60 sites along the pipeline during construction (Johnson 1981). Summaries and improvement suggestions for a future natural gas transportation pipeline were included in Walker and others (1987).

1977 & 1979: A.W. Johnson and Kubanis inventoried weeds along TAPS route from Yukon River north to Prudhoe Bay (Kubanis 1980, Johnson and Kubanis 1980).

1979 &1980: Native Plants, Inc. of Salt Lake City, Utah examined revegetation results within the pipeline corridor, plant succession patterns outside the corridor, and mycorrhizae on various plant species along TAPS route from Prudhoe Bay to Delta Junction (Native Plants, Inc. 1980a, 1980b and undated). These studies were sponsored by Northwest Pipeline Company for the Alaska Natural Gas Transportation System (ANGTS). A revegetation recommendation for Northwest Pipeline Company was produced.

For the past 20 years there appears to have been no published comprehensive inventory of the vegetation growing throughout the right-of-way with respect to revegetation success or failure. Obvious questions for a permit renewal are:

1) What are the current vegetation conditions along the corridor?
2) Which of the seeded species used in the revegetation program has persisted?
3) If seeded species are persisting, where do they occur?

During the summer of 1999, we undertook a survey of the vegetation along the TAPS corridor from Prudhoe Bay to Valdez to acquire answers to these and related questions. All vascular plant life forms were inventoried. There were no natural grasslands throughout the pipeline route. Yet grass species were seeded for revegetation because grass seeds were available and because grasses have desirable features to protect soils from accelerated erosion. Alyeska Pipeline Service Company also used willow cuttings and transplanted trees and shrubs at a few select locations.

Approach

During construction, the pipeline route was divided into six construction sections of equal length. These were numbered from south to north. Revegetation treatments were designed and applied by section. Thus, original seed and fertilizer applications were identifiable by construction section. This made our comparisons of current conditions to revegetation treatments relatively easy. The TAPS mile posts are numbered from north to south. The Dalton Highway mile posts are numbered south to north. The inconsistency in numbering patterns adds a degree of confusion to geographic designations for the route.

Twelve days were spent in the field, eight in July and four in September. Fifty-two sites were examined. Site locations were selected at approximately 15-30 mile intervals along the 800 mile route. Fifty-one of those locations were within the ROW, one location (site No. 42) was at the Isabel Construction Camp site. Site selection was based on ready vehicle access within the 15-30 mile sections. Some portions of the route were sampled more intensively, such as at Atigun Pass and at the Chandalar Shelf.

All vascular plant species observed within the ROW and in adjacent undisturbed communities were recorded at each site. Drainage, slope aspect, vegetation type and so forth were recorded for each location. Latitude and longitude were acquired and recorded as well as the TAPS milepost. At least four photos were taken at each site. Color transparencies (two 35 mm and two 6 X 7 cm) were taken of the ROW and adjacent vegetation. General vegetation conditions and results for grass species are reported here.

Results

It is important to note that this inventory depicts which plant species were present and where they occurred, but does not indicate their relative importance. Other sampling procedures that required more time than was available to us would have provided information on canopy cover, stem densities and so on. For the purposes of a general evaluation of the grasses used in the TAPS revegetation program and to determine which climatic zones were suitable for these various grasses, this survey method was adequate.

General Vegetation Conditions – 1999

The route crosses arctic tundra, alpine, interior boreal and coastal forest vegetation types. The arctic tundra includes wet sedge vegetation on the coastal plain and moist sedge in the northern foothills of the Brooks Range. Alpine vegetation occurs in the upper reaches of the Brooks, Alaska, and Chugach mountain ranges. The boreal forest zone extends from the base of the Chandalar Shelf in the Brooks Range to Valdez. Within the boreal forest zone, open shrub and herb tundra occur at higher elevations. At low elevations within the boreal zone, muskeg bogs form in poorly drained locations. Wildfire is a common natural disturbance of the boreal forest.

Various forms of solifluction are common in the mountains and sloping ground of the arctic tundra. Stream erosion and flooding occur along major river systems. Human disturbances increase around settlements, such as the mining district in the Brooks Range from Wiseman to Coldfoot. Sections between Livengood and Fairbanks have also been affected by various mining and related disturbances. From Fairbanks to Fort Greeley, various degrees of homesteading and other human activities have impacted the landscape. From Fairbanks to Valdez, there are a number of locations where small settlements and roadside businesses have variously influenced the vegetation. Some of these were from miliary activities, and several date from the days when overland travel between Valdez and Fairbanks was by horse-drawn wagons. Recreational use now seems to be the most widespread human activity along much of the route. Hunting and related activities occur from south of Prudhoe Bay to near the terminus at Valdez.

We found the route mostly well vegetated. In terms of numbers of plant species, forbs were the largest category represented. In aspect (visible prominence), shrubs and tree seedlings often dominated. Most of the grass species seeded during revegetation were still present. A few species of exotic weeds were found within the ROW, often within vicinities of settlements. No exotic species (either seeded or introduced) were found invading undisturbed communities.

Natural recolonization of the ROW in the boreal zone, from the base of the Chandalar Shelf to Valdez, resulted in a cover frequently dominated by woody plant species, shrubs and trees (Photo 1). This canopy has been periodically cut back by the pipeline company (Photo 2). Most of their brush cutting had been accomplished with mechanical brush cutters, producing a stubble of live shrubs and trees that resprout and eventually must be cut again.

Clearly, brush control is an ongoing process for the life of the pipeline. Mechanical cutting produces a mulch of chopped plant debris, much of which remains on the soil surface of the ROW. Some ROW sections had been cut by hand, and the cuttings stacked along the margin of the right-of-way.

Photo 2. Buried section of TAPS pipeline, north of Fairbanks (N65% 10' 19.3"; W147% 44' 41.2"), with right-of-way recently mowed to remove vegetation canopy. Without repeated mowing, this site would be dominated by brush and trees.

Photo 1. Cottonwood sapling and shrubs invaded around elevated pipeline in Dietrich Valley (23 July 1997). Vegetation development such as this occurs throughout TAPS corridor in the boreal zone. Alyeska Pipeline Service Company periodically cuts this growth either mechanically or by hand.

As with the mechanical brush cutters, hand cutting left a stubble that resprouted. Hand cutting produced no pulverized mulch, and it did less damage to moss and cover on the soil surface than mechanical cutting. Brush cutter wheels usually damaged the moss and lichen development on the soil surface. In some locations the thickness of moss and lichen development on the soil surface within the ROW was several centimeters in thickness and quite impressive.

Herbaceous vegetation often predominated along the edges of the compacted roadway. Woody species dominated portions of the fill that were not compacted by traffic and where seeded grasses failed to persist, such as outer edges and beneath the elevated pipeline. Vegetation development was greater where the substrate had an abundance of soil fines (silts and clays).

In the Native Plants, Inc. (undated) study of factors affecting natural recolonization, silt in the substrate was the most powerful. Based on Native Plants' findings, they recommended segregating the surface soil from the subsoil and placing the surface soil on the backfilled pipeline trench. This was reiterated in Walker and others (1987). I would concur with that recommendation, based on this survey. I have seen results of that type of construction in Scotland with the petroleum pipeline to Edinburgh. It simplified short-term revegetation and long-term right-of-way maintenance, regardless of the

Photo 3. Buried pipeline in northern foothill region of Brooks Range (MP 69, N69% 19' 03.3; W148% 43' 09.7"). Seeded Festuca rubra *and naturally established* Epilobium latifolium *dominate over the pipeline. Naturally colonized* Salix alaxensis *and* Salix lanata *var.* richardsonii *predominate along the margins of the gravel fill and overtop their counterparts in the adjacent undisturbed tundra community.*

type of vegetation or land use transected.

North of the boreal zone, herbaceous vegetation dominated the right-of-way, but often shrubs (primarily willow) developed stands along the margins of the fill, again where seeded grasses often failed. Two species of willow that colonized naturally along the margins of the gravel fill were considerably taller than counterparts in the adjacent tundra. The was most noticeable in the zone of the Sagavanirktok River (Photo 3). Grasses (often seeded species) usually dominated the central portion of the right-of-way in the section north of Atigun Pass, especially where soil fines were prominent. If the substrate was gravel, indigenous forbs (legumes, *Artemisia* and other members of Asteraceae) usually established to a greater extent than indigenous grasses.

In all, 245 vascular plant species were recorded within the ROW and adjacent undisturbed communities. The ROW contained the largest number of species (192) in contrast to the undisturbed communities (179 species). Much of the ROW contains fill, which was used to provide a firm, relatively dry surface upon which vehicles and construction equipment could be moved. A portion of the fill subsequently became the roadway for maintenance and operational traffic. This roadway sometimes is nearly overgrown with plants. At other locations, the entire roadway remains largely barren rock and/or gravel. Under the elevated pipe, fill is not compacted, and it usually became vegetated with indigenous species through natural processes. Over the buried pipe, vegetation has also established well, unless traffic has worn the plant cover. In the portion of the corridor that follows along the Sagavanirktok River south of Deadhorse, the oldest gravel fill that was fertilized and seeded to grasses supports a scattered stand of *Festuca rubra*. Over time, these habitats have been gradually invaded by indigenous forbs and now is our primary source of native seed collections for current gravel fill revegetation projects, such as along the Badami Pipeline.

Soil erosion emanating from construction and operation of the pipeline was not observed. We did find significant natural erosion in the Brooks Range. This was in the form of land slides that came down mountain slopes and crossed the pipeline route (Photo 4). Seeing these landslides reinforced the earlier statement by Mitchell (1970): "*The pipeline will avoid the bases of the mountain slopes as much as possible, since they are subject to considerable soil movement from frost action and solifluction.*"

There are ongoing pipeline maintenance operations that destroy vegetation. These isolated sites are revegetated on an as-needed basis by the pipeline operator. Sites with soil remaining after disturbance readily supported plants. Those sites consisting of gravel and cobble and few soils fines are among Alyeska's current revegetation problems. Plant materials suited to establishing plant cover on gravel are not commercially available, and must therefore be obtained from natural sources.

Table 1.

Frequencies of survival for species in Alyeska Pipeline Service Company's revegetation seed mixtures at sites inventoried in 1999. Listings are grouped by the six construction sections of the Trans-Alaska Pipeline. Frequencies of survival = (number of sites with species present in 1999/number of sites seeded to that species) X 100. Blank cells are construction sections in which the species was not included in revegetation seed mixtures.

Grass species names	Common names	Construction Sections					
		1	2	3	4	5	6
Agrostis alba	Red top					0	0
Alopecurus pratensis	Meadow foxtail	29	25	60	50	25	
Arctagrostis latifolia	Arctic polargrass						75
Bromus inermis	Smooth bromegrass	57	38	60	50		
Festuca rubra	Creeping red fescue	86	88	80	83	100	100
Festuca ovina[1]	Hard sheep fescue	0		0		0	0
Lolium multiflorum	Annual ryegrass or Italian ryegrass	0	0	0	0	0	0
Phleum pratense	Timothy	43		10	50	0	
Poa pratensis	Kentucky bluegrass	43	25	100	50	33	25

[1]*Festuca ovina* was not recorded separately from *Festuca rubra* in the 1999 vegetation survey. It is very likely *Festuca ovina* exists at various locations along the corridor.

Seeded Grass Species

Nine species of grasses (eight perennials and one annual) were included in four seed mixtures used to revegetate denuded areas along the TAPS corridor. Six of those grass species were found in our survey. Frequencies of occurrence among survey sites for seeded grasses are given in Table 1.

Agrostis alba was not found in any of the sites examined. It had been seeded in construction sections 5 and 6 (Coldfoot to Prudhoe Bay) of the route. These sections included the northern extremes of the boreal forest, alpine, moist- and wet-sedge tundra habitats. Because this forage and pasture grass is not commonly used in Alaska agriculture, its failure to survive in this TAPS revegetation program is not surprising. Alberts (1933) reported it failed to survive over winter at Matanuska. Irwin (1945) reported a summary of research attempts with the species; at the Rampart experiment station on the Yukon River, it was considered unreliable. At the Copper Center station, it winter-killed. At the Matanuska station it often winter-killed. Irwin concluded its potential in Alaska as a forage grass was confined to the coastal (not arctic) regions of the state.

Photo 4. Natural rock and mud slide that temporarily blocked the Dalton Highway in Atigun Canyon, Brooks Range (N68% 16' 22.8"; W149% 22' 42.0"). This slide carried debris containing huge boulders across the highway and under elevated TAPS pipeline, July 1999. These solifluction processes occur either when late or early mountain snows suddenly melt or when heavy rainfall produces excessive runoff. The pipeline route was chosen to avoid these situations as much as possible (Mitchell 1970).

Alopecurus pratensis was seeded in sections 1 through 5 (Valdez to Toolik). It persisted most frequently (60%) in section 3 (Tanana River crossing to Yukon River crossing) and 50% in section 4 (Yukon River to Coldfoot). This introduced, tall forage grass is occasionally grown for forage in some parts of Alaska, particularly on acidic and wet soils. It has a long history of testing for agricultural uses in Alaska (Irwin 1945).

Arctagrostis latifolia was included late in the TAPS revegetation program in seed mixtures applied to section 6 (Toolik to Prudhoe). This is an indigenous rhizomatous tall grass that periodically occurs throughout much the TAPS route. The varietal selection, "Alyeska", was released by Mitchell (1978, 1979, 1981). It occurred in 75% of the sites examined in section 6 of the ROW. These plants originated from natural colonization as well as revegetation seed applications. *Arctagrostis latifolia* was also recorded in construction sections 2, 3, and 5. Plants in these three sections were from natural colonization only, because commercial seed was not used in those locations.

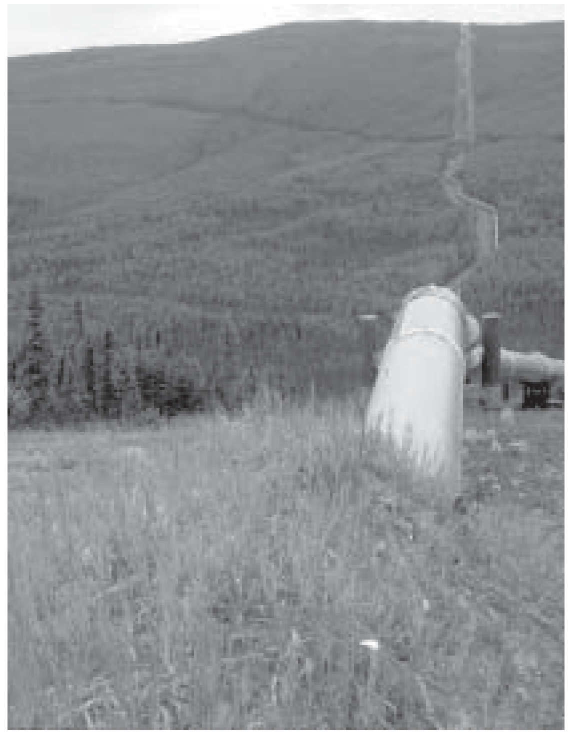

Photo 5. Seeded Bromus inermis *growing on mound of soil over buried pipe (MP 396, N65% 29' 26.5"; W148% 41' 17.9'). Survival of this grass species was greatest in this zone of the pipeline corridor. Note the right-of-way has been mowed to control canopy development by woody species, which would otherwise predominate.*

Bromus inermis (variety "Manchar") was included in revegetation seed mixtures from Valdez to Coldfoot, sections 1–4. It was present in each of these sections in 1999. Its greatest survival frequency (60%) was in section 3 (Tanana River to Yukon River) (Photo 5). Lowest frequency (38%) was in the alpine zone, section 2 (Gulkana to Tanana). This rhizomatous introduced tall grass is commonly used for forage and pasture in Alaska. This variety is a selection from the Pacific Northwest. The species originated from Europe (Hultén 1969).

Table 2.

Listing of all grass species recorded at 52 locations within and adjacent to the TAPS right-of-way, during the 1999 vegetation survey. Species are listed in descending order of frequency of occurrences within the right-of-way.

Grass species	Common Name	Derivation	Numbers of sites Inside ROW	Numbers of sites Outside ROW
Festuca rubra—Seeded	Creeping red fescue	Indigenous	46	1
Poa pratensis—Seeded	Kentucky bluegrass	Exotic	24	0
Agropyron spp.	Wheatgrass	Indigenous	21	4
Alopecurus pratensis—Seeded	Meadow foxtail	Exotic	16	0
Bromus inermis—Seeded	Smooth bromegrass	Exotic	16	0
Calamagrostis canadensis	Bluejoint reedgrass	Indigenous	15	13
Arctagrostis latifolia	Arctic polargrass	Indigenous	13	12
Hordeum jubatum	Foxtail barley	Indigenous	12	0
Puccinellia borealis	Boreal alkaligrass	Indigenous	10	0
Festuca altaica		Indigenous	9	19
Trisetum spicatum	Downy oatgrass	Indigenous	9	5
Agrostis scabra	Ticklegrass	Indigenous	9	1
Poa arctic	Arctic bluegrass	Indigenous	5	7
Phleum pratense—Seeded	Timothy	Exotic	4	0
Bromus pumpellianus	Arctic brome	Indigenous	3	2
Deschampsia caespitosa	Tufted hairgrass	Indigenous	3	0
Calamagrostis purpurascens	Purple reedgrass	Indigenous	2	1
Poa glauca	Glaucous bluegrass	Indigenous	2	1
Festuca baffinensis	Baffin fescue	Indigenous	2	1
Calamagrostis lapponica	Lapland reedgrass	Indigenous	1	3
Bechmannia erucaeformis	Sloughgrass	Exotic	1	0
Poa alpina	Alpine bluegrass	Indigenous	0	1
Arctophila fulva	Arctic pendant grass	Indigenous	0	2
Phleum commutatum (P. alpinum)	Alpine timothy	Indigenous	0	1
Dupontia fisheri	Dupontia	Indigenous	0	2
Heirochloe alpina	Alpine holygrass	Indigenous	0	3
Poa paucispicula (P. leptocoma)	Bog bluegrass	Indigenous	0	3

Festuca rubra was included in every seed mixture along the TAPS route, from Valdez to Prudhoe Bay. Two commercially available varieties were used, “Boreal” and “Arctared”. “Boreal” is a variety selected in Canada, and Arctared is a variety selected in Alaska. This species occurred in 89% of the sites, more than any other vascular species in this survey. The greatest frequencies of occurrence in this survey were 100% in sections 5 and 6 (Coldfoot to Prudhoe Bay). The lowest frequency, 80%, occurred in section 3 (Tanana River to the Yukon River). This mid-height, loosely spreading grass is indigenous to Alaska. It is commonly used for forage, turf, and revegetation. It is significant to observe that although the most common grass of the ROW, the species was found in the undisturbed habitat at only one location in this survey. We are fairly certain the specimens outside the ROW at this location were naturally occurring and not escapes from the revegetation treatment, because they differed in color and form from those seeded.

Festuca ovina was included in seed mixtures for four of the construction sections, 1, 3, 5, and 6 (Valdez to Gulkana, Tanana River to Yukon River, and Toolik to Prudhoe). We did not find any specimens of this species in our survey. It is likely this grass may have survived in portions of the ROW, and we just mistakenly grouped it with the red fescue. Our native species is generally confined to the Arctic, according to Hultén (1969). There may be some hybridization with *Festuca brachyophylla* (Hitchcock 1950). I have seen it at Prudhoe Bay and along streams in the National Petroleum Reserve–Alaska. The variety, "Durar", used in pipeline revegetation mixtures originated from the Pacific Northwest and is a selection from *Festuca ovina* var. *duriuscula*, which came to the U.S. from Europe (Hitchcock 1950). It has been tested as a forage plant for Alaska since at least 1930 (Irwin 1945). Based on those tests, it was judged winter hardy, a low producer, desirable forage for sheep, and well-suited as a turfgrass. The *Festuca ovina* var. *glauca* develops tufts with blue-green leaves and is often used as a border plant in the U.S. (Hitchcock 1950). Irwin (1945) listed sheep fescue (*Festuca ovina*) as one of several cultivated grasses adapted to Central Alaska from Cook Inlet to the Alaska Range.

Lolium multiflorum was a major component of every revegetation seed mixture applied from Valdez to Prudhoe Bay. We found no specimens of this species in our survey. This is an introduced annual grass, known commonly as annual ryegrass or Italian ryegrass, and it develops quickly from seed. It was included in seed applications to rapidly produce cover to control erosion and provide organic litter on the soil surface. It is sometimes used in Alaska to provide winter cover to cropland soils for erosion control. Because it is an annual, the species will not overwinter and become a competitor to crops, if it is planted too late for seed to form. It is also used to provide temporary cover to worn turf areas, such as playing fields. It may also be used as a forage plant.

Phleum pratense, variety "Engmo" was seeded in sections 1, and 3 through 5 (Valdez to Gulkana, and Tanana River to Toolik. We found it in sections 1, 3 and 4. It was not found in section 5 (Coldfoot to Toolik). Its greatest frequency was 50% in section 4 (Yukon River to Coldfoot). The next most common occurrence (43%) for this grass was in section 1 (Valdez to Gulkana). In section 3, where the other tall forage grasses (*Alopecurus pratensis* and *Bromus inermis*) persisted well, this species was found in only 10% of the sites examined. This introduced tall grass variety originated in Sweden. It is grown in Alaska for forage and historically it is considered especially good hay for horses.

Poa pratensis was included in all seed applications throughout the TAPS route, and was found at sites in all of the six construction sections. It occurred most frequently (100%) in sites in section 3 (Tanana River to Yukon River). It was found in 50% of the sites in section 4 (Yukon River to Coldfoot), and 43% of the sites in section 1 (Valdez to Gulkana). Two varieties of this grass were used, "Nugget" and "Sydsport". Nugget was seeded from Valdez to Gulkana, and Tanana River to Prudhoe Bay. It was not used in the alpine section from Gulkana to Tanana River. Sydsport was seeded from Valdez to Coldfoot. This rhizomatous species was introduced to Alaska. Hultén (1969) considered it a weed in Alaska. It occurs in disturbed sites throughout much of southern Alaska and at various locations northward. It is used as a turfgrass and in cultivated pastures. As a forage grass in Alaska, its production ranked below other grasses (Alberts 1933). It was the second most common grass species in our survey, occurring in 24 locations out of 52. We did not find *Poa pratensis* outside the TAPS right-of-way.

Significant Grasses Along the TAPS Corridor

A total of 27 grass species were recorded in this survey. Twenty-one were found within the TAPS ROW, and 19 occurred in adjacent habitats. Twelve species were common to both habitats. Six were found only in undisturbed habitats: *Arctophila fulva*, *Dupontia fisheri, Hierochloe alpina, Phleum commutatum, Poa alpina,* and *Poa paucispicula*. Eight were found exclusively within the disturbed habitat of the ROW: *Alopecurus pratensis, Beckmannia erucaeformis (a.k.a. Beckmannia syzigachne), Bromus inermis, Deschampsia caespitosa, Hordeum jubatum, Phleum pratense, Poa pratensis*, and *Puccinellia borealis*.

The listing of these grass species, sorted in descending order by relative prominence within the ROW is shown in Table 2. The three species most frequently recorded for the ROW were *Festuca rubra, Poa pratensis*, and *Agropyron* spp. (a group including *Agropyron boreale, Agropyron macrourum,* and *Agropyron violaceum*). Time in the field did not permit sorting out the *Agropyron* species. All three are indigenous, tufted plants that typically occupy well-drained soils along streams. They were usually found in this survey on rocky or sandy fill (Photo 6).

The three species of grasses most frequently found in habitats adjacent to the ROW were *Festuca altaica, Calamagrostis canadensis,* and *Arctagrostis latifolia.* These are indigenous species. *Festuca altaica* is a common, indigenous bunchgrass with a wide ecological amplitude. Its growth habit ranges from mid to tall, depending upon the site. It is found in open shrub tundra in alpine habitats as well as within black spruce forests). We encountered it within the ROW as well as in adjacent habitats. It appeared to have capacity to readily invade open ground along the TAPS route. Our northernmost record of this grass was at Site 10 at Trevor Creek in Atigun Canyon (latitude N68% 17'). Our southernmost record was east of Willow Mountain, south of Copper Center, Site 48 (N61% 47').

Photo 6. Naturally established Agropyron *spp. on rocky fill, TAPS corridor (MP 139.6, N68% 28' 49.3"; W149% 25' 07.5"). The indigenous grass dominated the aspect in this Brooks Range site east of Galbraith Lake.* Agropyron *does not occur in the adjacent undisturbed plant community.*

Calamagrostis canadensis is a very common tall grass. This indigenous, rhizomatous grass frequently dominates burned and cleared forest habitats in Alaska. It prefers moist soils and tolerates acidic conditions. Its tenacity for occupying a site often slows invasion by shrubs and trees, to the consternation of those interested in moose browse and timber production. Agricultural researchers have periodically evaluated this grass since 1898. With the impending development of the pipeline, Mitchell (1974) considered it a species with potential for revegetation. A variety, "Sourdough", was later released (Mitchell 1976). Its geographical range extends widely. I found a stand on the Coastal Plain in the Arctic National Wildlife Refuge several years ago. Selections seeded in plots at Prudhoe Bay by Dr. Wm. W. Mitchell in 1972 are still alive, even though the species has not reproduced beyond those plots. In this survey, the northernmost record of this grass was within the ROW at Site 17 (N67% 53') in the Dietrich Valley). In the pre-construction survey of the route, Mitchell (1970) reported the northern extent of this species was the Dietrich Valley, in agreement with our findings. This indicated to us that even though our sampling interval was relatively large, it was still sensitive to documenting ranges of major species. Our southernmost record was in the adjacent habitat at Site No. 52 (N61% 06') in the Lowe River Valley just above Keystone Canyon.

Arctagrostis latifolia was previously mentioned among the seeded grasses. This is a mid- to tall rhizomatous species with a relatively wide geographical range in Alaska. It tolerates wet acidic habitats. It does not require acid soils. The selection released for commercial seed production and included in seed applied to the northern section of the TAPS ROW grows taller, and has broader and lighter green leaves than the ecotype found in the adjacent tundra. In that region, one can usually distinguish the seeded variety from those occurring naturally. Our northernmost record for this grass was within the ROW at Site 1 (N70% 14'), about 0.25 miles south of Pump Station 1. At this site, it was growing on gravel fill placed in the shallow lake basin that was drained and became the site for Pump Station 1. *Arctagrostis latifolia* has colonized other portions of the lake basin, but it was not found adjacent to this particular site. Our southernmost record for *Arctagrostis latifolia* was Site 42 (N63% 12'), on the disturbed area of the Isabel Pass construction camp. Although *Arctagrostis latifolia* is noted for its tolerance of wet acidic soils, it may also invade well-drained gravel soil, as at the Isabel Camp site.

Hordeum jubatum was found at 23% of the sites examined. This indigenous bunchgrass is a relatively low-growing species. It occurs throughout the contiguous U.S. states, except the southeast and is believed to have been introduced to the eastern state from the West (Hitchcock 1950). It is a 'troublesome weed' particularly in irrigated portions of the West. In Alaska it is recorded from the Yukon River southward (Hultén 1969). It often occurs in heavy (clay) soils. I found it growing on the reserve pit clays at the Kemic Unit No. 1 abandoned drilling site in the foothills of the Brooks Range southeast of Prudhoe Bay (Photo 7).

In this survey, we found it only within the ROW. The northernmost location was site 18 in the Dietrich Valley, about 15 miles south of the Chandalar Shelf (N67% 51'). The southernmost record was site 48 (N61% 47') near Willow Mountain, south of Copper Center. The species probably entered the ROW through various means, such as an inclusion in the hay and straw mulches applied during revegetation, dropped from vehicles, and as a contaminant in revegetation seed mixtures. Seed of *Hordeum jubatum* is sold as an ornamental grass. For a brief period before maturity, the silky, reddish awns produce attractive displays. For the balance of the year, it remains an unbecoming, unpalatable bunchgrass, with a habit of persisting once it occupies open ground. It may provide cover to protect barren soils, but other species having more desirable features would be preferred.

Puccinellia borealis was found at 19% of the sites examined. This indigenous bunchgrass is a low- to mid-height species. It occurs naturally in Alaska from the North Slope to Southcentral. Hultén (1969) lists its habitat simply as 'moist places'. This species appears to have desirable features as a revegetation grass (Mitchell 1978). We found the grass only within the disturbed habitats along the ROW, and never in undisturbed communities. Sites in which this grass were found included fill portions of the ROW, margins of roads (Dalton Highway), and in the yard at Pump Station 12. In 1993, I found it growing on a heap of drilling mud at an abandoned drilling site east of Umiat. It occurs in waste areas around buildings at Umiat. In recent years, it has begun to appear at various places in the Prudhoe Oil Bay Field. Most frequently it appears near truck loading docks and building entries, where muddy boots are cleaned by people just entering the field.

Photo 7. Hordeum jubatum *established on drilling muds in drained reserve pit at the Kemic Unit No. 1 exploratory drilling site (N69% 26' 25"; W147% 16' 11", upper drainage of Shaviovik River, foothills of Brooks Range) (16 August 1993). The well was spudded 1 January 1971 and suspended 17 June 1972. Salinity of drilling wastes were low, indicating considerable leaching had occurred since drilling. The site is at the 1,100 ft elevation. No revegetation practices were known to have occurred at this location. It is uncertain how this grass species was introduced in the site, which is considerably north of* Hordeum jubatum*'s geographical range.*

Lynden Transport, Annex 3 loading dock, and ERA Helicopters locations are examples. This suggests it is being moved to Prudhoe by Dalton Highway traffic and by helicopter users that are visiting sites outside the oil field. Our northernmost encounter along the TAPS route was within the ROW at Site 15 (N68% 03'), atop the Chandalar Shelf. The southernmost record was Site 48 (N61% 47'), in the Willow Creek drainage south of Copper Center.

Conclusions

Currently the ROW is well vegetated (Photo 8). Ironically, the most prominent vegetation management activity by Alyeska Pipeline Service Company in 1999 was cutting brush that had invaded the ROW. This is opposite the situation in the 1970s, when the major activity was seeding and fertilizing to establish vegetation within the ROW.

Six of the nine seeded grass species still persisted within the ROW in 1999:
Alopecurus pratensis (meadow foxtail)
Arctagrostis latifolia (arctic polargrass)
Bromus inermis (smooth bromegrass)
Festuca rubra (creeping red fescue)
Phleum pratense (timothy)
Poa pratensis (Kentucky bluegrass)
A seventh species, *Festuca ovina* var. *duriuscula* (hard sheep fescue) may have survived and been mistakenly grouped in this inventory with *Festuca rubra*.
Two of the originally seeded grass species failed to persist:
Agrostis alba (red top)
Lolium multiflorum (Italian or annual ryegrass).

The two most frequently occurring species, *Festuca rubra* and *Poa pratensis*, were both found in all sections of the ROW. *Festuca rubra* was the most common vascular plant species recorded within the ROW. However, it occurred naturally at only one location outside the ROW. *Festuca rubra* occurred most frequently in the Arctic (Coldfoot to Prudhoe Bay). *Poa pratensis* occurred most frequently in section 3, from the Tanana River crossing to the Yukon River.

Festuca altaica, Calamagrostis canadensis, and *Arctagrostis latifolia*, respectively, were the most common grasses in the adjacent undisturbed plant communities. All three of these indigenous grasses have invaded the ROW at various locations. No seeded exotic grass was found to have invaded into the adjacent undisturbed plant communities.

Acknowledgments

Appreciation is expressed to Anne Brown and Ray Jakubczak for their interest in seeing this project through to completion. Chipper Loggie and Marko Radonich were involved with arranging financing from BP Exploration (Alaska), Inc. and the other pipeline owner companies. Peter Nagel, Alyeska Pipeline Service Company, was instrumental in securing permission for us to access the pipeline route and on occasion providing lodging and meals at TAPS pump stations during the field survey. Dave Norton, Alyeska Pipeline Service Company, encouraged project development. Steve McKendrick was responsible for collecting soil samples, recording site information and GPS locations for most of the study sites. Dan McKendrick assisted with the soil sampling in July 1999. Conce Rock assisted with the soil sampling and site data recording in September 1999. Roseann Densmore provided her copies of the

Photo 8. Well-vegetated cut through which the Trans-Alaska Pipeline was buried north of Fairbanks, Alaska. Cut banks on either side of the right-of-way are covered with indigenous shrubs, primarily alder. The central portion of the right-of-way is dominated by a mixture of seeded grasses and indigenous plant species that are growing on the subsoil remaining after construction. In the absence of periodic brushing, the woody species would most likely dominate much of this site. There has been no repeated fertilization of this site. Vegetation is surviving on remaining elements in the original fertilizer applications and natural sources in substrate.

Native Plants, Inc. reports. Laboratory services for soil testing were purchased from the Alaska Agricultural & Forestry Experiment Station at Palmer. The following individuals reviewed this article: Peg Banks, Ray Jakubczak, Phillip D.J. Smith, David (JD) Norton, Pete and Judy Scorup, Jon Globic.

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Boreal Alkaligrass (*Puccinellia borealis*), Is This the One?

• *Jay D. McKendrick*

"*Find a grass that will grow quickly, cover bare soil and then self destruct, letting the natural tundra come back.*"

Those words, or ones very similar, were from Atlantic Richfield Company to William (Bill) W. Mitchell and me nearly 30 years ago, as we launched a three-year tundra revegetation research project (Mitchell and others 1974). Bill Mitchell, originally from Montana, had attended universities in Montana and Iowa State University and had come to Alaska several years prior to work with indigenous grasses on a Rockefeller Foundation project. Plant taxonomy and ecology were his specialties. It was my first year in Alaska. I was originally from Idaho and had attended the University of Idaho and Kansas State University. My specialties were soils, range and plant ecology. Mitchell was responsible for the plant selection and testing. He had recently collected several prospective species from a tour of the proposed pipeline route (Mitchell 1970). I was to handle the soil fertility portion of the new tests at Prudhoe Bay.

By the end of June 1972, our tests were underway in the Prudhoe Bay Oil Field. Our sponsors were anxious for positive results, and both they and we were encouraged as the grasses Mitchell (1973) had seeded emerged. My fertilizer test plots were seeded to spring rye, an annual specifically selected to develop growth as rapidly as could be expected in the Arctic, but not to overwinter. We wanted to avoid introducing exotic weeds to the region, and annuals do not persist in the Arctic.

Curious growth patterns developed among my fertilizer test plots. Some rye plants grew vigorously, some less vigorously, and some not at all. Clearly we had a soil nutrient deficiency affecting this grass. I was anxious to attach numeric values to those growth patterns. Near the end of August we went to Prudhoe and harvested a third of the fertilizer plots immediately upon our arrival. The next morning we returned to complete the task, only to discover caribou had done it for us. The entire seeding was grazed to the ground, leaving us with no quantitative data to report to our sponsors.

The next season (1973), the fertilizer plots were seeded again in a fenced area. We were only partially successful in controlling grazing that year and learned caribou can jump fences as well as crawl through them. However, enough quantitative data were obtained to identify phosphorus as the element producing the most remarkable growth in the spring rye.

After two years of losing out to grazers, I decided to take a new approach. The contract was ending, and we were obliged to deliver useful

Photo 1. Three year old stand of Puccinellia borealis *on a site from which natural tundra was removed by bulldozing, followed by two summers of rototilling to kill all original plant species (2 September 1997). The entire area was seeded to* Puccinellia*, but plants only established in plots given phosphorus fertilizer.*

Photo 2 Same view as in Photo 1 after Puccinellia borealis *was replaced through natural processes by wet-sedge tundra plant species (12 August 1995).*

information and plant materials.   Several times I inspected Mitchell's arrays of grass tests and noted that while his plots also were grazed by caribou and geese, one grass (*Puccinellia borealis*) was avoided, and it grew well. Bill Mitchell generously provided what I needed for use in my fertilizer tests that year (1974). His collection was a perennial originating from near Kotzebue. It rated well in field tests in terms of establishment and growth (Mitchell and McKendrick, 1974). I was pleased to find something that would grow and escape the grazing damages by pests that were interfering with 'important' research progress.

Several grasses suited to tundra revegetation as well as other habitats in Alaska were identified

Photo 3. Puccinellia borealis *in its second year of growth to barren tundra soil in the Prudhoe Bay Oil Field*

(Mitchell 1974, 1976, 1978, 1979, 1981), though none were known to 'self destruct'. Alkaligrass was still considering possibilities of boreal alkaligrass as late as 1978 (Mitchell 1978). Our contracts for tundra revegetation were completed, oil began flowing from Prudhoe to Valdez, and other projects took me from Prudhoe to NPRA. I was consulting for Husky Oil NPRA Operations, as Phillip D.J. Smith seeded and fertilized drilling sites during the second exploration of NPRA. On some trips, I went through Prudhoe and made quick checks to see how the fertilizer tests were doing. In 1981, things looked normal. There was grass in the phosphorus plots and a few forbs where phosphorus had not been applied. I did not get back to those plots again until 1984.

Photo 4. Same plot as shown in Photo 1, Puccinellia borealis *in its third year of growth (2 September 1997).*

Something remarkable happened between years seven and ten in the test plots. *Puccinellia borealis* was being replaced by natural tundra species. In the oil spill on wet sedge peat soil (McKendrick and Mitchell 1978), *Carex aquatilis, Dupontia fisheri, and Eriophorum angustifolium* were gradually occupying the phosphorus-treated plots that had previously been dominated by *Puccinellia.* A test area which we had bulldozed and tilled for two summers to kill all the original vegetation was becoming a wet sedge meadow again, dominated by *Eriophorum angustifolium* (Photos 1-5).   The old winter haul road that was the home of our most extensive fertilizer test (and which had been so unmercifully grazed in

1972- 1973) was producing a complex of dry-site tundra plants (Photos 6-7). In every situation, *Puccinellia borealis* was fading from the scene,

Photo 5. Same plot as shown in Photos 1 and 2, wet-sedge tundra occupying ground previously dominated by Puccinellia borealis *(12 August 1995).*

and natural tundra plants were returning.

Was *Puccinellia borealis* the species to 'self destruct'? I went to see Mitchell for more grass seed and reported what I had observed. He told me he had discarded the collection. For the next nine years, I looked for the grass in the Prudhoe vicinity but found none. Then on 17 August 1993, BP Exploration (Alaska), Inc. asked me to inspect a number of abandoned drilling sites. After fueling at Umiat, we headed east and landed at the first well site. As the helicopter was cooling down, I looked out the window and saw a pure stand of *Puccinellia borealis* growing on a mound of drilling mud (Photo 8). The seed was ripe and shattering, and I harvested a small bag full with my pocketknife.

Photo 6 Graduate students, John Swanson and Steve Archer, sampling fertilizer plots that are producing only Puccinellia borealis*, which had been dormant seeded in 1974. The grass in this photo was in its third year (1 September 1977).*

I have since found the species in several locations, but no finding was as welcomed as that at East Umiat No. 2. Northern Native Seeds of Palmer, Alaska, planted a small production field of *Puccinellia borealis* (Photos 9 and 10) and has supplied seed to us for three projects. In 1997, a seeding test was imposed on a diesel fuel spill at Milne Point (McKendrick 2000a). In 1998 and 1999, we seeded the Badami overburden stockpile and the Badami No. 1 exploratory drilling site (McKendrick 2000b, 2000c). In 2000, we applied seed to an area of drilling mud near Point MacIntyre No. 1. It will be used in other locations, as the need arises, such as the shore crossing of the North Star pipeline, backfilled areas of the Badami Pipeline river crossings and so on. I think it should be given strong consideration for use in the natural gas pipeline revegetation planning. It may not be the last answer for tundra revegetation, but it does add an alternative previously available.

Features of *Puccinellia borealis*:

- It can be grown for seed increase in agricultural areas of Alaska.
- It begins seed production the second year after establishment.
- Seed yields are quit high.
- Some strains produce two seed crops a year.
- It establishes quickly.
- It is a weak competitor in the Arctic.
- It tolerates a wide range of soil conditions in the

Photo 7. Same view of fertilizer test plots as Photo 6, 18 years later (10 August 1995). Puccinellia borealis *is absent from these plots, having been replaced naturally by indigenous dry-site tundra plant species.*

Arctic (wet to dry, acidic to alkaline, saline to non-saline, organic to mineral, and crude oil and diesel spill sites).

• It only persists long-term on habitats that other species cannot tolerate, in other words, heavy clay and saline soils.

• Palatability is low a year after establishment. That means grazers are less likely to destroy new seedings of this grass.

Photo 8. Naturally-established stand of Puccinellia borealis *on mound of drilling mud at East Umiat No. 2 exploration site (N69% 21' 33"; W151% 51' 43") (17 August 1995). Exploratory drilling was conducted at this location between 15 April and 21 May 1969. This was the seed source for our collection of* Puccinellia *that was used to establish a seed production stand near Palmer, Alaska.*

Shortcomings:

• Plants may be susceptible to diseases when grown in large stands.

• Plants may be relatively short-lived (5–10 years in the wild).

• It may have limited utility beyond revegetation, which will largely affect the economic aspects for potential seed producers.

Acknowledgments

Appreciation is expressed to Wm. W. Mitchell for including the author in the original tundra revegetation research projects. Thanks go to the companies: Atlantic Richfield, Alyeska Pipeline Service, Canadian Arctic Gas Study Limited, Exxon, Shell Oil, and Union Oil for their sponsorship of the original tundra research project, and to John Sweet and Frank Fisher who were instrumental in arranging the contract between these sponsors and the Institute of Agricultural Sciences, University of Alaska. Phillip D.J. Smith, Husky Oil NPRA Operations, ensured opportunities to stop at Prudhoe Bay on trips to NPRA. Peter C. Scorup, Northern Native Seeds, produced the first commercially available supply of boreal alkaligrass and assisted with seedings at Badami, Prudhoe, and Milne Point. Daniel McKendrick, Dan Cooley, and Bill Baker were summer hires who prepared and installed seedings. Steve McKendrick and Peg Banks assisted with vegetation evaluations of seedings. BP Exploration (Alaska), Inc. and ARCO Alaska, Inc. funded multiple studies and project tasks for the past 16 years, many of which were helpful in evaluating this plant long-term and in a few opportunities applying it to revegetated damaged tundra sites. Rob Soreng, Smithsonian Institute, visited our Prudhoe Bay sites in the summer of 2000 and helped clarify names of the several alkaligrass species in the area. Gratitude is expressed to the following reviewers: Peg Banks, Phillip D.J. Smith, Pete and Judy Scorup. Finally, the Alaska Agricultural & Forestry Experiment Station made possible much of our discovery of the long-term aspects of boreal alkaligrass.

Photo 9. Rows of Puccinellia borealis *in seed production field near Palmer, Alaska. Plants in this field were seeded earlier in the growing season of the year this photo was taken 16 September 1995.*

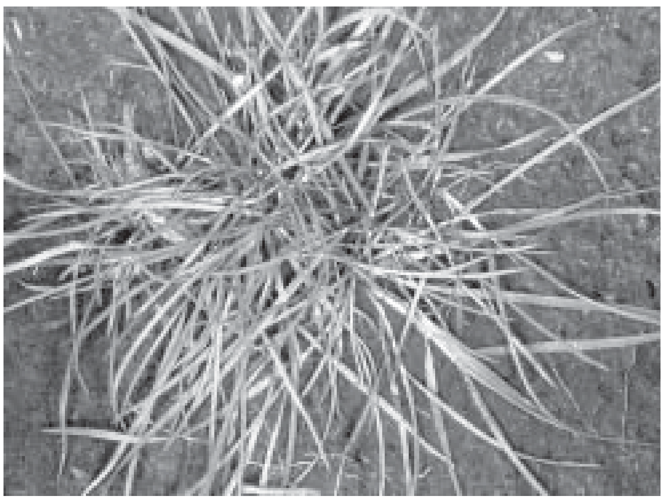

Photo 10. Close view of Puccinellia borealis *plant in seed production field near Palmer, Alaska (16 September 1995). Seed for this plant was collected 3 years earlier from the natural stand shown in Photo 8. Grass plants in this seeding produced seed the following growing season.*

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Mitchell, W.W. 1981. Alaskan-developed grass varieties coming into use. Agroborealis 13:56-58.

[1] The correct name for this grass is *Puccinellia borealis* and not *P. arctica.*

[2] The correct name for this grass is *Puccinellia augustata*, not *P. langeana.*

Implementation of Silvicultural Systems for Alaska's Northern Forest

• *Edmond C. Packee (simulations by John Shaw)*

Author's Note: In a previous paper (Packee 2000) I described concepts of silvicultural systems, with an emphasis on Alaska's Northern Forest. In this paper, the implementation of silvicultural systems is presented.

Silviculture is both an art and a science. The art (along with the science) is in applying silvicultural systems and harvesting methods to the landscape, which may be a forest consisting of many stands or a single stand. However, silvicultural systems and harvesting methods are not equivalent.

A silvicultural system is a stand-specific prescription designed to best achieve the objectives of the landowner; it is more than simply regenerating a or thinning a stand. A harvest method is one of many tools used in bringing about these silvicultural objectives.

The term silvicultural system derives from the regeneration method, which is based on the biological requirements of the tree species to be regenerated. There are five basic regeneration methods: clearcut, seed tree, shelterwood, selection, and coppice. Packee (2000) presented some of the variations for the shelterwood, selection, and coppice methods.

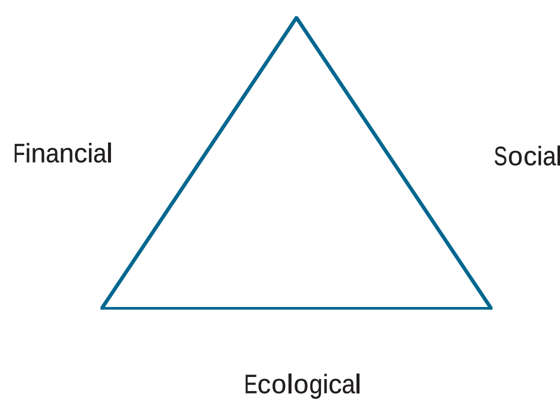
On the other hand, only two harvest methods exist: clearcut and partial cut. Harvest methods basically remove trees regardless of size. Harvest methods create growing spacing for tree regeneration as seedlings or sprouts, or more growing space for trees already present.

Management Objectives and Biological Criteria

Implementing a silvicultural system requires a clear understanding of the landowner's desires and objectives. The landowner may be a small property owner, a corporation with or without converting plants (sawmills, veneer plants, or refineries to produce forest chemicals such as ethanol, birch syrup, and pharmaceuticals), or a public agency.

Obviously each of these entities have very different objectives. In developing objectives, the landowner determines the objectives within governing laws and regulations. In the case of public agencies, the public communicates their desires, both of the majority and the minority, which in unison determine how the agency develops the objectives.

However, objectives cannot be developed without considering the biological, social, and economic constraints. This can be approached by using the sustainability triangle:



Often misunderstood about the sustainability triangle is the idea that the three sides are of equal weighting or importance. They are not. Management objectives cannot exceed the range of ecological constraints without risk of major failures unless major financial commitments are made. But these financial requirements may not be socially acceptable.

Social demands commonly exceed the ecological constraints. Oftentimes in interior Alaska, the social demand is to keep the forest natural—as we see it today. In the riparian zone, the no-cut buffer idea ignores the past cutting history along major rivers such as the Yukon and Tanana and thier tributaries. Cutting was done for sawlogs and sternwheeler fuelwood, and fire was used by natives to control insects and improve game habitat prior to Russian and American settlement (Roessler and Packee 2000).

Of equal concern has been the perception that the forest is static, changing little, when it is indeed dynamic (Pielou 1988, Oliver and Larson 1990). The ecology of the species, communities, and ecosystems provide the ecological constraints or realities outside of which one cannot manage sustainably or effectively. Emphasis in this paper is on the ecological constraints for implementing a silvicultural system; by this is meant that the end results must be ecologically achievable.

Pre-Harvest Silvicultural Prescription

Development and implementation of a silvicultural system begins with a Pre-Harvest Prescription, more appropriately, a Pre-Harvest Silvicultural Prescription (PHSP). British Columbia, committed to a high level of sustainable forest management, has a strong forest management program that requires site specific PHSPs on all crown lands. A Pre-Harvest Silvicultural Prescription is "a framework for collecting information and making decisions about how best to use the natural productivity and potential of a site to serve specified management goals. [They] are the forerunners to detailed operational plans for harvesting, regeneration, and silviculture on a site. In effect, they are site-specific management strategies" (Hadley and others 1990). The PHSP is essential for developing long-term objectives—it provides the groundwork and logic for developing site (stand) specific objectives. The PHSP is site (stand) specific, however, one can expect similar sites to have similar PHSPs and thus, for specific ecosystems and stands, a standard prescription can be developed.

The PHSP "process begins with the assessment of a site and its resource values, to identify site and resource variables that must be considered in the development of operational plans. [It] identifies the sensitivity of the site and its resources to impacts from harvesting and other forest management operations. …resource values and site sensitivities… are addressed with local experts and in consideration of [all] resource uses, to develop a forest management strategy for the site that reflects all resource-use concerns and includes the necessary provisions to maintain site productivity" (Hadley and others 1990).

Once the information concerning the site has been collected and analyzed, the PHSP sets forth "the forestry activities, the methods that will be used, and the proposed constraints necessary to protect the site and its resource values" (Hadley and others 1990). The PHSP develops a management plan that is based on the ecological base of the sustainability triangle. In the case of Alaska state lands, the PHSP provides the ecological basis for the Forest Land Use Plan (FLUP). In all cases, it provides an ecologically sound, integrated site management plan in which social constraints (concerns) are considered and upon which to address financial considerations.

Davis and colleagues (2001) provide five essential elements of a prescription:

1) statement of goal(s) describing objectives for the stand;

2) identification of historical (natural and human-caused) events that created current stand;

3) land-unit identification and classification—location, site characteristics, soils, vegetation community (overstory and understory);

4) management treatments and schedule—activities, timing of activities, methods, conditions to manipulate vegetation;

5) quantitative projection of conditions and outcomes—stand growth, successional changes, and habitat conditions until next harvest.

Hence, the PHSP sets a trajectory for the new target stand. Prior to developing the prescription, the person preparing the PHSP must determine and record what the future stand is to look like at rotation (time of next major disturbance such as harvest or fire). For the Northern Forest in Alaska, Packee (2000) identified 13 basic forest cover types as possible goals. These goals can be refined to include desired height, diameter, and quality of final crop trees. Crop trees can be considered from various perspectives: fiber, aesthetics, wildlife habitat, riparian protection and enhancement.

When is the time to develop a PHSP—before, at the time of the activity, or after the activity? The best time to assess site characteristics is before finalizing harvest unit boundaries, whether for a mature timber harvest or a thinning treatment. Hadley and colleagues (1990) recommend two to three years prior to harvest activity; minimally, in Alaska where the desire is a coppice stand, it could be 18 months prior to harvest. Hadley and colleagues (1990) also state, PHSPs "are carried out at a time of year when the site conditions allow for site characteristics and resource status to be assessed. It is important that the area be free of snow, that the ground not be frozen, and the vegetation can be identified." The argument can be made that many sites being considered for harvest are winter access only; in large portions of British Columbia, timber harvest access is also by winter roads and ice bridges as in Alaska. Nonetheless, in British Columbia PHSPs are required and they are done during the appropriate time of year.

Pre-Harvest Silvicultural Prescription is a planning tool. To be an effective planning tool requires experienced personnel to do the site assessment and the prescription. This requires resource managers to increase their time in the field and spend less time in the office.

As a planning tool, the PHSP permits :

- rapid and reasonably accurate determination of the ecological unit(s) to which a site belongs and, hence, use of a standard prescription upon which to build or revise;

- identification of sensitive areas in terms of habitat concerns, harvest equipment, regeneration effort including success/ failure concerns, seedlot requirements, planting stock needs, site preparation, and treatments before and after free-to-grow status;

- allows development of site-specific management strategies—goals are to take advantage of existing condition and to avoid creating problems.

A good PHSP provides for good public interaction. A good PHSP is based on science that supports management goals and silvicultural actions.

The public is becoming more astute in forestry matters and more and more science is being demanded. A good PHSP provides accurate, factual site information; the scientific basis for planned activities; the opportunity for dialogue based on science and not just rhetoric; and the opportunity to review a site before ad after harvest, to see if changes need to be made in order to meet the target. A poor PHSP provides the opportunity for ample and justified public criticism before and after silvicultural actions are undertaken, provides no opportunity for forest certification and potential market losses, and may lead to the loss of a professional claim to manage forest lands.

A good PHSP provides many management benefits:

- ensures that short-term actions are planned to serve the long-term management strategies;

- identifies resource conflicts well in advance, and thus allows for timely mitigation;

- identifies streams or wetlands and potential or optimum crossing locations;

- determines if advance regeneration is adequate or probable and, if so, how to take advantage of it by changing time of harvest or specifying type of equipment to be used;

- if plans are to plant seedlings, allows for ensuring that seed is available and nursery beds available in order to minimize delay of regeneration effort;

- identifies patches of critical wildlife habitat to be excluded from harvest or treatment or future treatments to benefit wildlife (such as planting conifers more densely to create nesting habitat conditions for the Townsend warbler);

- permits, through identification of the ecosystem and current stand conditions, development of standard silvicultural prescriptions and identification of treatment needs;

- defines target benchmarks to determine, through monitoring, if the stand is on target;

- provides records so that 20 years later the third manager for the site knows what was attempted and why.

Pre-Harvest Silvicultural Prescription Development

Development of PHSP typically involves six stages:

1) pre-harvest assessment;
2) identification of issues and options;
3) development of the prescription;
4) review the prescription with all parties involved;
5) finalize;
6) place into practice.

In addition, a monitoring plan should be in place to ensure the stand is kept on the trajectory planned to meet the target. This allows for adaptations to the original prescription to bring the stand back onto the desired trajectory. If it is economically unfeasible or socially unacceptable to maintain the planned trajectory or target, then a revised target is developed and the reason for the deviation is provided. An example of a target no longer being feasible is if the stand is flooded by beaver dam construction and the majority of trees die. An example of a socially unacceptable target is conducting a planned thinning in a stand now containing an eagle's nest.

Once the stand is located, field data collection is initiated. Field data collection includes the location and physical description of the site. Location may include latitude and longitude, an aerial photo with approximate boundaries located, GPS coordinates or boundaries, watershed, and stand number. Physical characterization of the site includes elevation, aspect, slope percent, position on slope, and landscape configuration. Minimal basic soils information includes thickness of the organic layer and texture of the upper mineral layers—especially those with abundant roots. These describe the abiotic (non-living) factors affecting forest productivity and limitations to human manipulation.

Both overstory and understory stand information are essential and include per acre estimates of all tree stems, diameters, and a sample of trees to obtain an age estimate through coring. Understory vegetation is described, both presence and abundance of any species, in order to determine the community type. Selected trees (dominant and co-dominant) are measured for height to determine site index—a measure of productivity. This provides the biological data used to determine what the desired stand should be at the end of the rotation or at maturity (a desired stand structure or given age).

After basic data are obtained, issues and options are identified. Issues and options must be addressed based on the objectives of the landowner and as stated in management plans. Objectives vary from owner to owner and from one management plan to another. Site sensitivity issues are identified; these include such things as access, retention of established regeneration, soil trafficability, presence and quantity of disease or insects. Then the prescription is developed and reviewed with individuals directly or indirectly associated with the land unit. The review is designed to fine-tune the prescription; this is not the place for challenges to the objectives nor for the interjection of information known prior to the development of the prescription unless genuinely missed. The prescription is now fine-tuned and finalized and the actions to achieve the prescription are initiated.

Prescription Options for an Alaska Mixed White Spruce–Aspen Stand

Figure 1 illustrates the general appearance of a natural stand of white spruce and aspen for which five silvicultural treatment options were simulated. Stand data to develop Figure 1 were collected in 1995 on a Permanent Sample Plot in interior Alaska, as part of the Alaska Agricultural and Forestry Experiment Station's Forest Growth and Yield Program. The management objectives for the stand are: provide moose browse to increase subsistence hunting opportunities; provide sawlogs and fuelwood for the local economy, and regenerate or maintain a mixed stand of aspen and white spruce that will provide the same opportunities 120 years from now.

Figures 2 through 6 are simulations that show results 30 years after five different treatments:

1) **Do Nothing** in which nature is allowed to grow without human interference;

2) **Clearcut** in which all trees (230 per acre) were harvested and no trees remained standing;

3) **Seed Tree Cut** in which 210 trees per acre were harvested and 20 white spruce trees per acre were left standing;

4) **Shelterwood Cut** in which 183 trees per acre were harvested and 47 white spruce trees per acre were left standing;

5) **Selection Cut** in which 31 trees per acre were harvested and 199 white spruce trees per acre were left standing.

The simulation used the Lake States version of the USDA Forest Service's Forest Vegetation Simulator model (USDA Forest Service 2001). The Lake States version was used because currently, a version does not exist for the non-coastal forests of Alaska. Admittedly, this is not a perfect fit. A major problem with the Lake States model is the presence of species not found in Alaska—several of the simulations indicated the occurrence of eastern white pine (*Pinus strobus*) in the simulated stands; for illustrative purposes, I simply merged these with white spruce and refer to them in the stand summary data as conifer.

Discussion

In Figure 2, aspen regeneration did not occur and by year 2095, only two aspen were present in the stand. These two aspen are probably quite large and old—the stand is losing the aspen component. Also note that the cubic-foot volume per acre declined over time. In Figure 3, clearcutting resulted in a pure aspen stand—excellent for moose browse, but the conifer component is not present. Aspen regenerated from root suckers (coppiced) and excluded spruce regeneration. Do nothing and clearcutting resulted in the lowest cubic-foot volumes per acre. Neither treatment achieved the desired objectives.

The seed tree reproduction method produced the greatest number of aspen per acre at year 2035; inspection of the simulation data indicates that from time of harvest, much higher numbers of aspen were present. The seed tree method met both the stated objectives.

Neither the shelterwood nor the selection method supported a substantial quantity of aspen. Looking at the volume per acre, the numbers are skewed upward because of the eastern white pine; however, in terms of timber production the selection method appears to be the best approach.

However, after the harvest, the selection method had 6173 cubic feet to the acre and the clearcut had none. In effect the selection, shelterwood, and seed tree methods had a head start over the clearcut. Subtracting 6173 cubic feet from the year 2095 cubic volume indicates that mortality exceeded the amount of timber left standing on the stand in 2005. Thus the selection approach did not achieve the objectives either.

Application of this type of an approach to the non-coastal forest of Alaska is most tempting. However, the example here is only an illustrative effort to show what could be done. It shows that silvicultural system options must be carefully applied on a stand specific basis. It shows that no one reproductive method is standard. The example presented here is fraught with problems.

A major recommendation from this simple example is that a non-coastal version of the USDA Forest Service Forest Vegetation Simulator is essential to improve and refine forest stand prescriptions and management options for the non-coastal forests. The Forest Growth and Yield Program of the Experiment Station is collecting field data to support the development of non-coastal version of the Simulator.

Acknowledgements

I wish to acknowledge the help of Mr. John D. Shaw, formerly a graduate student within the School of Agriculture and Land Resources Management of the University of Alaska Fairbanks, and currently finishing his doctorate at Utah State University, Department of Forest Resources and Ecology Center. Without his knowledge and effort the simulations would never have occurred.

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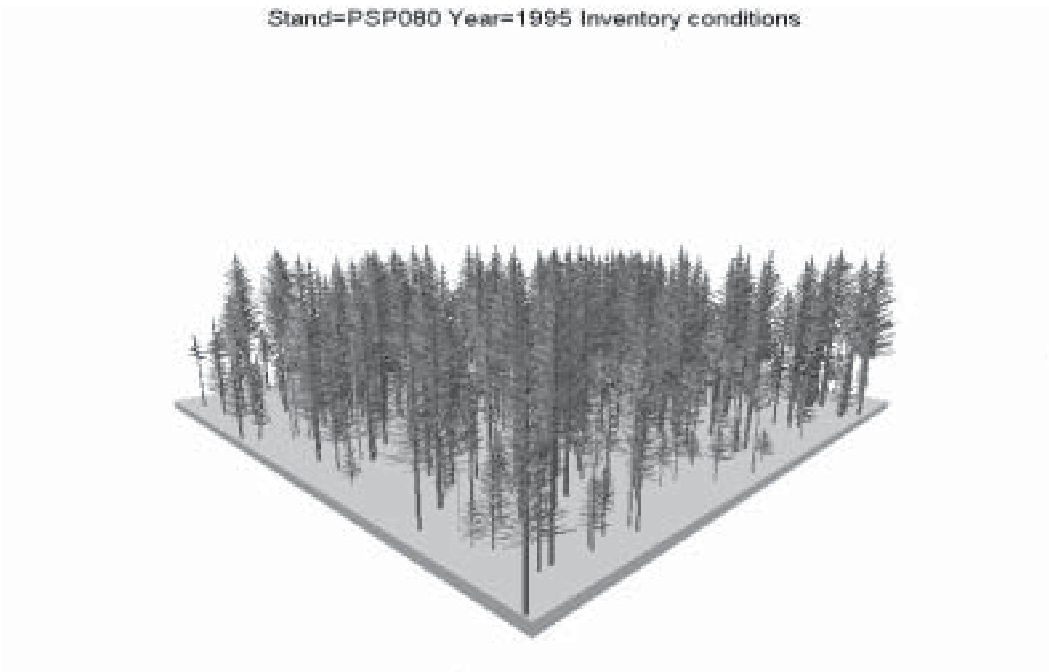


Figure 1. Natural Stand, Year 2005, Stand description, per acre basis
1995: 333 spruce, 57 aspen; 3773 cu.ft.
2005: 198 spruce, 32 aspen; 6243 cu.ft.

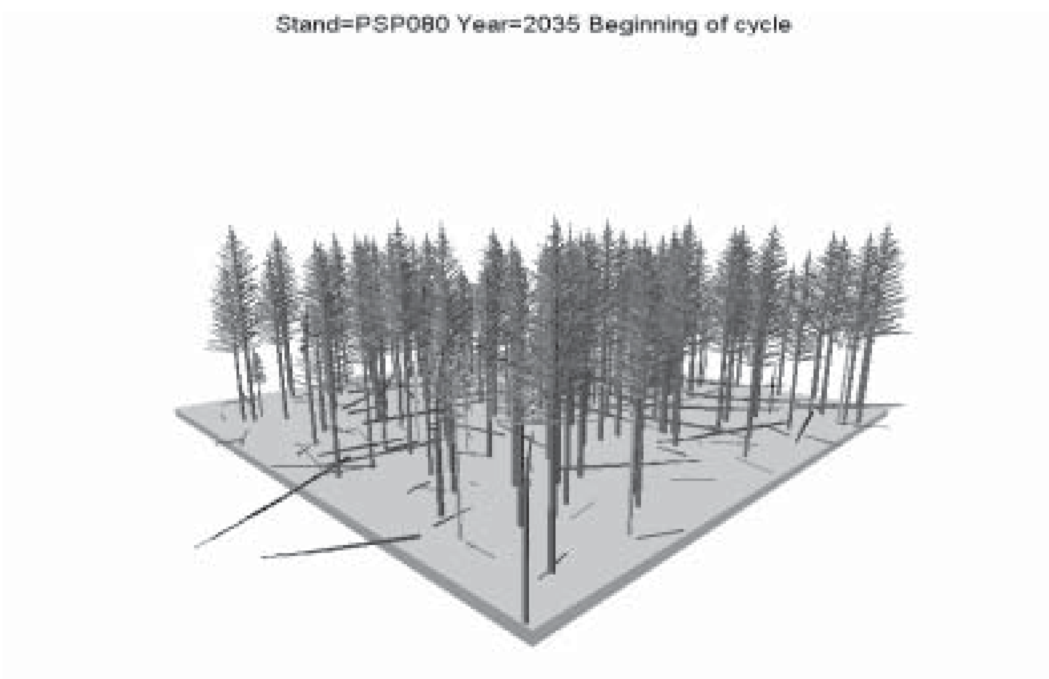


Figure 2. Do Nothing, Year 2035, Stand description, per acre basis
2005: 198 spruce, 32 aspen; 6243 cu.ft.
2035: 73 spruce, 7 aspen; 5232 cu.ft.
2095: 15 spruce, 2 aspen; 2133 cu.ft.

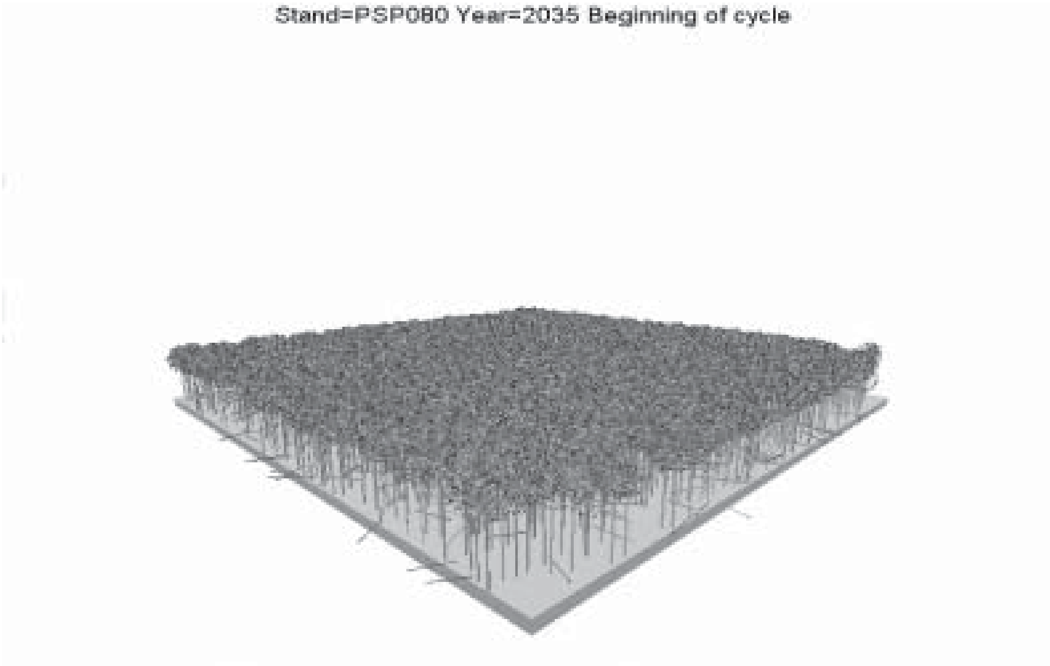


Figure 3. Clearcut, Year 2035, Stand description, per acre basis
2005: 0 spruce, 0 aspen; 0000 cu.ft.
2035: 0 spruce, 1852 aspen; 0000 cu.ft.
2095: 0 spruce, 299 aspen; 2953 cu.ft.

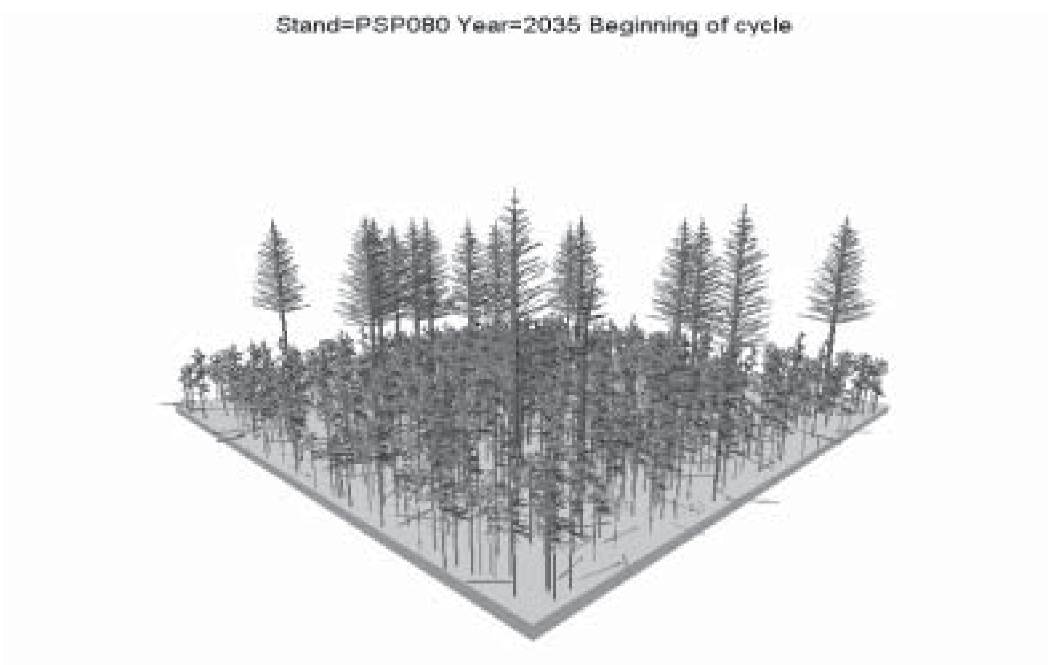


Figure 4. Seed Tree, Year 2035, Stand description, per acre basis
2005: 20 spruce, 0 aspen; 1843 cu.ft.
2035: 643 conifer, 181 aspen; 2521 cu.ft.
2095: 547 conifer, 0 aspen; 7741 cu.ft.

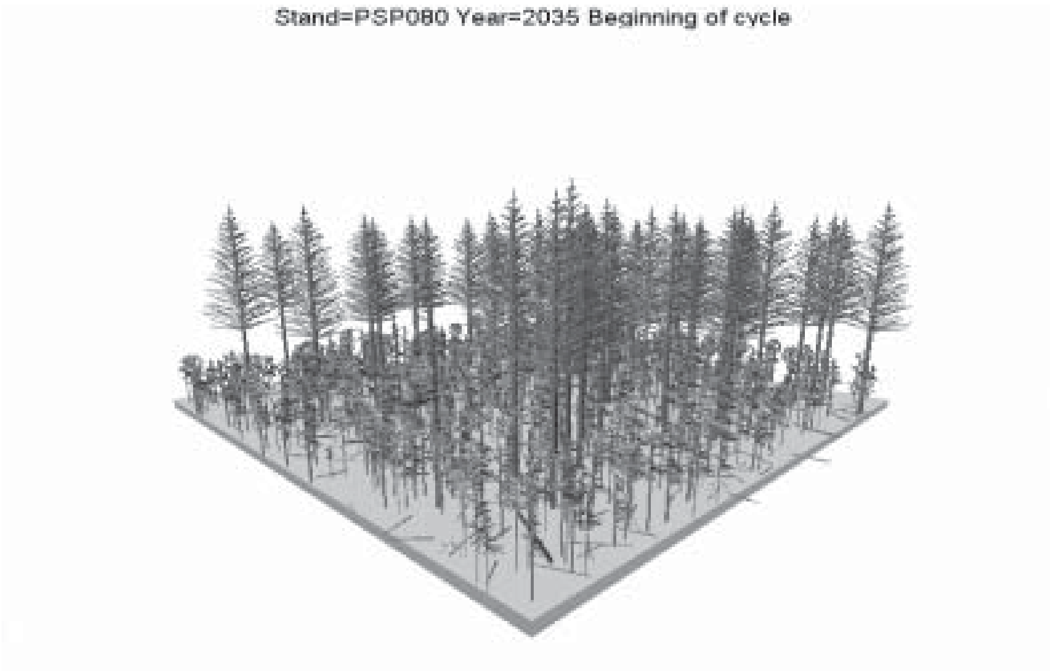


Figure 5. Shelterwood, Year 2035, Stand description, per acre basis
2005: 48 spruce, 0 aspen; 3120 cu.ft.
2035: 643 conifer, 78 aspen; 5126 cu.ft.
2095: 486 conifer, 0 aspen; 4070 cu.ft.

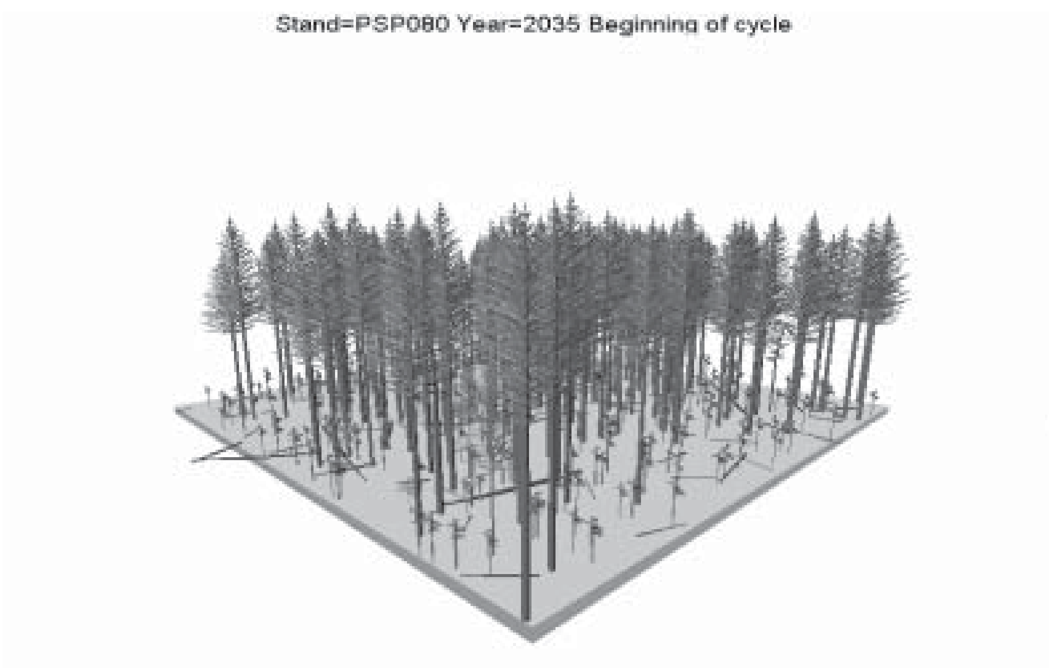


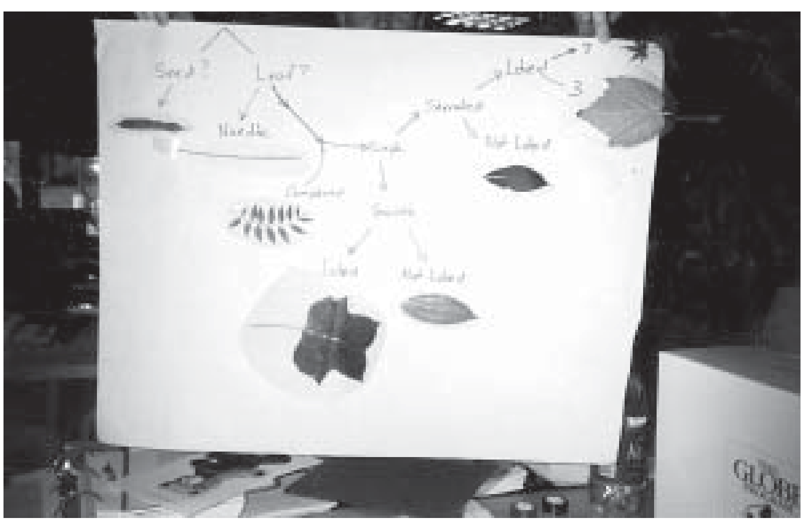
Figure 6. Selection, Year 2035, Stand description, per acre basis
2005: 199 spruce, 0 aspen; 6173 cu.ft.
2035: 415 conifer, 4 aspen; 10493 cu.ft.
2095: 255 conifer, 0 aspen; 5799 cu.ft.

Innovative Ways of Integrating Global Change Education in K-12 Classrooms

• *Elena Sparrow*

Here in Alaska, we are breaking new ground in science education— by engaging K-12 students in global environmental change research, scaffolding their local studies with the knowledge and observations of Native elders and other community experts, and using standards-based science and math best practices to support the teaching and learning processes.

Our three-year project on "Global Change Education Using Western Science and Native Observations", recently funded by the National Science Foundation, has enabled us to start reaching students in urban Alaska and in rural Alaska, where there are more than 200 remote communities. To do this we first had to reach out to school teachers—by sending out flyers and application forms for the first two-week summer institute of the project, "Observing Locally, Connecting Globally" (OLCG) . We informed and invited teachers using regular mail, email, list-serves and phone calls.



Students classify leaves using a dichotomous key they designed.

We were gratified to have a tremendous response within Alaska, and from outside Alaska including Canada, Norway and Russia. This program had apparently attracted a lot of interest. A particular area of interest was the opportunity for students to participate in original research, in order to spark creative thinking using concrete simple observations, to work on scientific problems and conduct research on issues in their everyday lives. As one teacher remarked "Environmental studies, especially at the grassroots level, is a way to make science relevant to the students".

Another area of interest was the Global Learning and Observations to Benefit the Environment (GLOBE) program (*http://www.globe.gov*), a major component of the OLCG institute and the project. One teacher wanted to use GLOBE for teaching Earth Sciences, and another teacher to help students get science experience that is more than reading and doing simple experiments. "What I've seen of GLOBE is that it lets students act as scientists, performing activities that can be really used" (teacher application 2000). Others saw GLOBE as a way of involving students in long term environmental monitoring, learning more computer skills, posting data on the Internet and connecting globally.

Participants were also very interested in linking western science with Native knowledge and traditional science. One teacher fervently expressed "My students and their families have a great hunger for a connection to their Native culture that is not fulfilled because so much has been lost. Integrating Native knowledge in the classroom could be one step in trying to stem this loss." Another teacher saw the importance of combining western ways and Native ways of knowing as a means of gaining a richer and more diverse science base and a better way of integrating other subjects and content areas in the classroom.

Some teachers from rural areas with limited resources were looking for ways to enhance their

Middle School students determine dissolved oxygen levels in a local river.

science curriculum and expertise. Other teachers were interested in hands-on science methods and integrating science content, research and the Alaska standards for K-12 students. Others wanted more relevant ways to increase their students' environmental awareness and understanding of the global environment, and to integrate environmental studies in their curriculum.

We had a fairly rigorous application process for the program and teachers were asked to respond to questions about why they wanted to take part in the project and what they thought they could contribute to the project. Of the 18 teachers selected to participate in the program and in the first OLCG summer institute, four were high school teachers, eight were middle school teachers and six were elementary school teachers. Collectively, these teachers with diverse science backgrounds brought with them more than 90 years teaching experience, a keen interest in environmental studies and lots of enthusiasm for learning and teaching their students.

We had a fully packed schedule for the OLCG institute in order to cover the three main project components: 1) western science using research methods developed by the GLOBE program, 2) Native knowledge and observations, and 3) best science classroom teaching practices to enable teachers to engage their students in locally relevant environmental studies.

We jump-started the institute with a field trip on the Tanana River to Fox Farm, owned by Wes Alexander, the only five-time winner of the Yukon 800 Riverboat Marathon. The other expert Athabascan boat captains were Howard Luke—a well known and respected Native elder, who has lived nearby and earned a living off the river his whole life—and Sam Dimientieff, of the Demientieff Navigation family, who grew up delivering goods by boat and barges to communities on the Tanana, Yukon, Koyukuk, Iditarod and Innoko rivers. These Native experts regaled us with their personal experiences of living off the river and land, and enriched our understandings of earth as a system—the interconnections of water, soil, atmosphere and living things—all necessary in studying global change. As they skillfully piloted the boats on the river, they demonstrated how long-term, repeated careful observations and holistic/systems-thinking were critical not only to monitoring the environment, but also to navigation and survival.

Students take current, minimum and maximum daily temperature readings within one hour of solar noon.

Back in the classroom, we tried to put into practice the ideas of long-term observations and systems thinking as we started on the GLOBE protocols and learning activities. This was combined with input from Inupiat elder Jonas Ramoth and Koyukon elder Catherine Attla, and other community experts like Dixie Dayo and Mary Shields. For each of the GLOBE areas of investigation (Hydrology, Atmosphere/Climate, Soils, Land Cover/Biology, and Earth Systems) we covered, we used the format of Native knowledge followed by GLOBE protocols. We believe the coupling of knowledge and experience of Native elders and other community experts with science instruction and research investigations, enhances the cultural well-being, science skills and knowledge of students. This belief seems to be shared by both Native and non-Native teacher participants as exemplified by their comments: "I've always been interested in combining science and Inupiaq knowledge," and " I've been looking for more connections with my local experts and am thrilled to be basing it around student-generated research".

During the institute, we addressed underlying philosophical and pedagogical concerns with regard to culturally responsive science teaching— through assigned readings, discussions, and modeling. The assignments we gave to the participating teachers required integration of Native knowledge along with GLOBE protocols. One of the most useful references we used was the *Handbook on Culturally Responsive Science Curriculum* (Stephens 2000).

We discussed and modeled best classroom practices, such as:

- establishing a constructivist learning environ ment,
- teaching and assessing to standards,
- inquiry learning in science,
- learning cycle model, and
- teaching and assessing for diversity.

At the end of each day we asked teachers to write their understandings and concerns from the day's activities. We adjusted the schedule of the institute daily as we became aware of the participants' needs.

The teachers learned and practiced calibration of instruments and GLOBE research procedures. They learned how to measure current, maximum and minimum air temperature, amount of solid or liquid precipitation, pH of rain or snowfall, cloud cover and cloud type, water temperature, pH, transparency or cloudiness, conductivity, salinity (dissolved oxygen, and nitrate content optional), soil temperature, moisture, pH and bulk density. They also learned how to characterize soils (by determining the number of soil horizons, texture, structure, consistence and pH in each horizon),

Students enter data on the GLOBE data server, which can be accessed at http:// www.globe.gov.

establish a qualitative land cover site, determine exact site locations using a Global Positioning System unit, classify land cover using the Modified UNESCO Classification (MUC) system, do biometry and manual land cover mapping, and gather plant phenology data at the start and end of the plant growing season.

Additionally, teachers learned to enter and visualize data through the Internet on the GLOBE server. During the institute the teachers formulated their own research questions and working in small groups, conducted an inquiry study on their land cover/biology plots. During the final evaluation presentations, the teachers encapsulated and demonstrated in a presentation what they had learned during the institute. We thoroughly enjoyed the various well thought-out and prepared presentations employing "multiple intelligence" (Gardner 1983), which ranged from Powerpoint slide presentations, poems, Native dance and singing, and puppet shows, to lesson plans and learning activities that can be used in their classrooms.

Participants were given instrument kits and materials that their students could use in conducting their local environmental studies. When teachers returned to their classrooms, we continued to support them through emails, phone calls and some school visits. With the guidance of these teachers trained in GLOBE, Native integration and best science classroom practices, their students are involved in global change research and have started taking environmental measurements at or near their schools. They join hundreds of thousands of GLOBE students in more than 90 countries, who have reported data from millions of measurements.

These global data sets are freely available via the Internet to the world-wide science community and to schools for student inquiry, scientific research, student-scientist partnerships and world-wide school-to-school collaborations. Students recorded, in addition to data they have collected, their thoughts regarding their involvement in the program (what they learned and what they liked or disliked). One high school student who was not enthralled about his program involvement reflected that what he was learning would probably be useful to him for a job later in life and that he would appreciate them more at that point. Overall, students' comments have been mostly positive.

Teachers submitted their reflections on their implementation of various parts of the OLCG institute and the Global Change Education program into their classroom. Some teachers shared their frustrations with program implementation stemming from other school requirements—such as new standards in all subject areas and the lack of time to do them all, or from the delayed arrival of needed hydrology research supplies coupled with freeze-up of the lake being studied, or bears frequenting their study areas putting a halt to their measurements. Other teachers shared successes they termed "stunning" or "awesome"—such as students really listening to a Native elder and being able to relate what they had learned in class to the things the elder was talking about—resulting in discussions that sparked high school students' interest, who then began quizzing 5-8th graders about their science activities. Others described the elation of students upon seeing their school on the map and their data on the GLOBE server, and inquiry activities where their students were learning from their observations and each other, and then began asking each other questions and figuring out answers—putting together pieces of understanding which were growing into larger concepts and coming up with more questions. Another teacher talked about how Native knowledge, GLOBE methods and best classroom teacher practices combined in a Salmon Study Unit that kept students busy and interested.

We are very much encouraged and enthused from the first year's results, but have a lot more to learn as we continue working with our teachers and prepare to work with additional teachers and their students. For more information about the program, contact:

Elena Sparrow (principal investigator) at *ffebs@uaf.edu,*

Sidney Stephens (co-principal investigator) at *ffss1@uaf.edu,*

Leslie Gordon (co-principal investigator) at *lgordon@northstar.k12.ak.us),*

or Martha Kopplin (program liaison) at *mkopplin@northstar.k12.ak.us*.

Also, visit our web site at *www.olcg.uaf.edu.*

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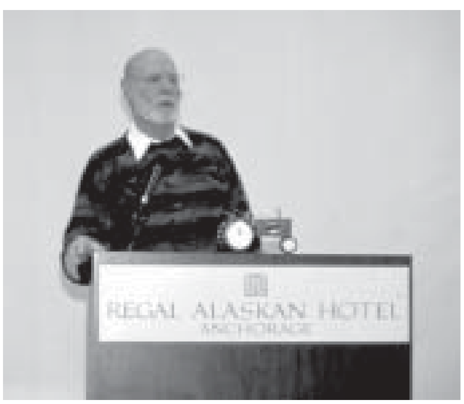
UA President Mark Hamilton On Education and Agriculture

Editor's Note: The following is from a speech President Hamilton gave at the 2000 Alaska Agriculture Symposium on November 11, 2000

It is a great pleasure to be here today. Especially when I discovered that we have a number of folks attending from outside of the state and all the way over from Canada.

As I saw this (small toy) tractor sitting up here on the podium, it reminds me of a very painful John Deere tractor story! When I was a young man and I was still in high school my uncle ran the Morris Town county fair up in Jersey and he had a big John Deere tractor. We didn't have all the rules of the road for tractors and licensing but as long as I drove it on the fair-grounds that was okay. It looked just exactly like this tractor. I was sitting up there on my uncle's tractor and being kind of proud of myself and doing little chores.



One day I had to pull this stump up and so I backed up the tractor and put the chains around the stump. At that time I thought the John Deere tractor could pull anything and so I put it in gear and the front end of the sucker started to stand up and I realized just pulling it would not work. But I was a teenager and so I was pretty smart! I thought all I needed to do was back this tractor up and get a running head start. You see these little things up here in front (pointing to the tractor's exhaust manifold), those hurt when you grab them like that! So if you got to pull a stump, get the tension on the line and you won't have the thrill. (laughter)

As I walked through the display area earlier today and did a little bit of visiting today, you learn something every time you do that. I did get to talk to you two years ago and as I recall after I got through speaking, Tony (Nakazawa) and our Cooperative Extension faculty grabbed me on the back porch, and they just kind of laid out what it is that we need to do to put this program back on. You just heard this morning four additional extension folks in place and one on the way (referring to new permanent extension faculty positions in Fairbanks, Anchorage, Palmer, Delta and Bethel). Now in the (SALRM/AFES) research arena we have two new faculty in Fairbanks, [and] three more coming to specifically address issues raised at meetings like the one with extension two years ago. The three we don't have onboard yet are plant pathology, weed science and entomology. So we are getting the staff back to serve the state.

Extension is a *service* organization. Extension used to be called Cooperative Extension Service. Marshall Lind put the word *service* back in there. By the way, please give me some advice on my chancellors. This guy has been here a year so far, so how is he doing so far? (applause)

This isn't an accident or this isn't because I have my own small history in love of agriculture and all of what that society stands for; it has to do with a very simple reality. I run the University of Alaska, it is not my university, it's your university. That institution in order to become and remain an integral part of this state and its future needs to do one single thing. It needs to respond to the needs of the state of Alaska and to the degree that you have helped to focus those, you have been a central part in all that has happened. I didn't get you five extra people, I didn't get you almost $2 million worth of research monies, I didn't get you two researchers here and three more on the way. You got them! You directed it, you encouraged it, you focused it and that's the way its going to always have to be.

You can't set up the university and decide where you're going to go. Because you just are not going to be right often enough. Talk to the people of this state and find out what they do for a living and what they want this state to be. I will tell you something, if you are going to change the nature of the state, the university is just not one way to do it. It's the only way to do it! Education and focused research are the only way any state or any developed nation has ever developed. You can't get there any other way. The idea of focusing and directing and supporting investment in your state university is something that Alaskans have got to learn how to control. Too long the university has been *apart* from this state instead of an integral part of this state.

Agriculture is just not a part of Alaska's history, it's a part of the future. This isn't as people will tell you in this state, I tell you that there aren't five people in this state that get to travel around as much as I do. I consider that a great privilege. Let me tell you this, we've got to make it very clear to the people of this state that agriculture in Alaska is not a failed experiment, but a promising developmental opportunity. A message has to be put out there because you know the perception on agriculture that is out there is wrong. I promise you this—we need to work at getting agriculture's message out; let's work at that together.

If agriculture is going to be a part of Alaska's future, we have to start to think about the future. We've got to take charge of this future; we have to take charge of the economy of Alaska. We have long lived in a boom–bust economy. There is a great bumper sticker out there—it says, "Please God let there be another oil boom and I promise I won't throw it away this time." Or words to that effect! Let me tell you when you throw away a boom...you throw away a boom and you've failed to prepare Alaskans...you take the legacy of jobs from them—I mean the jobs that last after that first flush of construction is over.

Those that control the Alaskan economy and those people who have held these jobs for a very, very long time have not always been Alaskans. You could see it in every part and parcel of this state. I don't care if you are talking about schoolteachers, or if you are talking about nurses or if you are talking about oil field workers. These industries are complaining, "I've got an aging work force." It always upsets me a little bit when they look at me with near tears in their eyes and they say, "My average force is 49 years old!" I happen to remember that 49 was a particularly productive year! Let me tell you I will send out a dog sled with some Geritol and in the meantime if we can just keep those old fogies alive a little bit longer—you tell me what type of workers do you want me to produce, what's the nature of the work, what's the job, what's the courses you want to take, what's the skills sets?

We got together with the process industry career consortium, put that course together and got 168 youngsters and not- quite-so youngsters involved in that course. The two-year course was to produce some people who will replace the old workers on the slope, so when you go to two weeks on and earn that money and then two weeks off, you come back to Alaska and spend it here. This is what you have to do. We should have picked that up before. This cold chill came over me when I recognized this. I am all excited about this program! We are doing such a successful thing in cooperation with the industries of the state. And then I realized these people they are replacing have all been hired 25 years ago. It says this, says the penalty is if you miss the boom—the next shot you get at it is a quarter of a century later! That's when all those folks were hired.

Well let me tell you something. Another boom is coming; I haven't got a crystal ball, but my best guess says there is going to be a gas pipeline, well my bet says at least one. Are we having an extension of the rail? Take it to the bank. Ballistic missile defense, probably. E-business, global logistics, it is coming. It is going to happen! We have to start thinking ahead of time. (going to flip chart)

I just drew this up; here is what I have been drawing up around the university throughout this summer. Now this is supposed to look like this. Here is what everybody tells me. Everybody tells me, now we've got this gas pipeline coming down.

It's got to go like this. We need another sheet of paper, because you know what I think, because I think there is a gas pipeline going in, I think there is a railroad going in and I think it goes this way. I think we have connectivity here we need to start to think about. I think we need to say that's a gas pipeline and it is not an oil pipeline. You want to know the difference? You talk me into an oil pipeline—you are going to have two handfuls of brown sludge. Tap into a gas pipeline and the dry gas portion of that burns at the wellhead and what is on-site is an abundant inexpensive energy source. What happens there? If we know about where that root is going to go, how is that going to effect us around that root to have available abundant inexpensive on-site energy?

You know we have tons, and tons and tons of tomatoes coming out of the Anchorage Airport and flying out to California. Do you where they come from? McKenzie River. How are they grown? With controlled environment. Where do they get the energy, from the gas pipeline? Let's start thinking. Let's start figuring out where this thing is going? What does it mean for us? Where should we tap off of that? Let's make sure they [Alaskans] drive the fiber optic cable and the railroad drags the telegraph line and strikes the fiber optic cable, otherwise you will just have development on the other side of the digital divide.

Let's face it, there are agriculture opportunities here, economic opportunities here for all of Alaska, but who is going to decide where it's built? Well it won't be us, unless we are there. And our decisions makers do the best they can, but we've got to have the information. I had 22 professors across the Alaska university system at my house last week and I said we would apply the science to inform the decision makers.

We've got to know where we are going, the future is magnificent, but we have to be a part of it. One of the things we need to do for the future was mentioned here today. I told you two years ago I'm going to stop the rancoring. We cannot continue to export our brightest youngsters out of this state and hope to be anything. We currently have the lowest number percentage-wise of youngsters going to college of any state in the nation. And of those that go, we have the highest percentage that leave; those are both bad. When you multiply them together, they're dismal. During the last decade of the last century, Alaska lost 20 percent of its population between the ages of 18 and 35. We have to identify where we are going and have to identify the jobs, get the university and other agencies to produce and train some people who will take us into the 21st century. Where Alaskans are in charge of their economic destiny and not sitting around making bumper stickers. The next one is going to have to say, "Oh Heck, best three out of five!" Let's get ahold of this thing and let's go forward.

I want to tell you about this Alaska scholarship program. It works! We've got 600 youngsters right now in only two years. Six hundred youngsters at the University of Alaska in various campuses, some in Mat Su and a bunch in Anchorage, got them in Kenai, got them in Fairbanks, lots in Fairbanks. These youngsters change in the university and they are going to change the state of Alaska.

I want to tell you something about that program. First of all it is a very simple program. If a student graduates in the top 10 percent of an accredited high school in the state of Alaska, you will get four years tuition free in any campus of the University of Alaska system. You want to go Outside, good luck, but I'm not paying for it. What we've got here is a very important decision to keep this thing going that we have gotten started. In the top 10 percent on an SAT score or standardized exam or anything else; it is the top 10 percent in every single high school in our state.

On Veteran's Day I will tell you exactly why that decision was made. I believe the most important piece of legislation ever passed in the history of our nation was the GI Bill. It allowed Americans who would never have had a chance any other way to go to college. They changed who we are. They changed the future of the United States of America. On the world level the United States of America has to face competition that is absolutely unfair because every other nation continues to compete with their historically-educated elite and we brought the whole team.

That is why the Alaska Scholars Program is for every high school in Alaska; we need the whole team in Alaska to go into the 21st century. We don't just need oil, we don't just need mining, we don't just need agriculture, we don't just need fisheries; we need the whole team going forward into the 21st century!

Let me tell you—an investment in education is not one way to get there, it is the only way to get there. I didn't get these positions for Cooperative [Extension], you got them. I will tell you exactly why it happened. There is a change, frankly, from that segment of Alaska many of you represent. Relatively conservative folks say "cut that government, cut that government, cut that government," and on the other side of the mouth say "that university isn't doing anything for us." That translates into cut the university and we are in a death spiral. Well turn that around a little bit, you turn that around and we have voices from the Valley for the first time in memory last year saying, "I think we need to invest in the University of Alaska."

Those extension positions and that research money coming next (SALRM/AFES) is the direct result of your support. It is not my money. I am going to apply it to the needs of Alaska. If you identify those needs for me and you support us in the legislature with your cards, letters and opinions, and say this is valuable to the university and help us here to support the university, we can continue what is now a very, very nice upwards spiral.

I really like talking with and to this group of people because for some reason with this group of people you just don't have to beat around the bush. You are a very straightforward group of folks and I want to tell you something. When our support and our commitment, when my support and my commitment to you and the business sector you represent, when it is over I will tell you—and it ain't over, let's go get them!

Questions from Audience:

Q – Well four of my five children have already graduated from college, but when they were in school they could not get the classes they needed when they needed them and so it took them longer to graduate. Can you address that issue?

A – You are right; Alaska offers one-half to two-thirds, depending on the degree, of the majors we see in similar institutions our size. I am not talking about Harvard or Yale; I am talking about North Dakota, South Dakota, Wyoming; they offer twice as many or half as many majors.

In order to offer more majors you have to have more support. One of the primary criticisms of the University of Alaska when I got here two years ago was that you are trying to be to many things to too many people. That is an accusation that is absolutely wrong; it is absolutely backwards; we are not able to meet the needs of what Alaskans demand and so we have youngsters who leave Alaska to go to school.

Now we cannot ever have every course imaginable in America. At some stage of the game if some youngsters want to pursue something that there are not a whole bunch of Alaskans that want to pursue it, we are just going to have to sadly say get a great education, but please come back. You can't create courses for every person in Alaska. But you can meet the needs of Alaskans. If the need is great enough then the people will support the funding of the university.

Let me tell you something that is very important to understand about the University of Alaska. It is not a business; if we get more students, that doesn't mean we make more profit—tuition covers about 40% of the cost of education. When we get more students I've got to go get more money from the legislature. Now this is not a terrible thing; it does say however you better know what you are offering and it better meet the needs of Alaskans or it won't have the support to go get the money. You will always be running a deficit and that won't be working very well for the university.

If we are committed to areas that Alaskans don't care about, we are going to be absolutely on our own instead of in conjunction with Alaskans. Getting back to your question, you are correct, no doubt about it, we are looking very hard across this state to determine exactly what those courses need to be.

School of Agriculture & Land Resources Management – 2001 Graduates

Shannon L. Christensen	A.A.S.	Northern Management Technology: Interdisciplinary Program
Marcus Alan Bingham	B.S.	Natural Resources Management
Rodlyn M. Bundy	B.A.	Geography
Rodlyn M. Bundy	B.S.	Geography – Environmental Studies
Tanna Lee Carter	B.A.	Geography
Jamie Carl Coady	B.S.	Natural Resources Management
Dane E. Crowley	B.S.	Natural Resources Management
Frank DeChambeau	B.S.	Natural Resources Management
Thomas Earl Dilts	B.S.	Geography – Environmental Studies
Clayton E. Dunn	B.A.	Geography
Takanori Ishii	B.A.	Geography
Daniel C. Jordan	B.S.	Natural Resources Management
Matthew James Mahoney	B.S.	Natural Resources Management
Akiko Matsui	B.S.	Geography – Environmental Studies
Kelleigh Erin O’Brien	B.A.	Geography
Robert W. Smith	B.A.	Geography
Brian Michael Walker	B.A.	Geography
Michael Shane Walker	B.S.	Geography – Environmental Studies
Angela Danielle Wohlford	B.S.	Geography – Environmental Studies
Justin Dorsett Zimmerman	B.S.	Geography – Environmental Studies

Natural Resources Management 2001 Scholarship Recipients

Vincent Waters..Eugene Evancoe Scholarship.................. $500

Ray Gene Tilbury..SAF Dixon Entrance Chapter..................$1000

Craig Bosveld..SAF Richard Tindall Scholarship.............. $500

Marie Klingman..Bonita J. Neiland Scholarship................ $500

News & Notes

Women in Agriculture

Kathy Burton was awarded the Outstanding Women in Agriculture Award at the Alaska Agriculture Symposium on November, 2000. The annual award recognizes contributions of Alaska women to agriculture in the state.

Ms. Burton has served Alaska's agricultural community for more than 30 years as a rancher and producer of cattle, bison, elk and horses. She and her husband Bill and son Buck established the Kodiak Cattle Company and Kodiak Game Ranch on a 22,000 acre lease on the eastern coast of Kodiak Island.

The Burtons produce game animals for meat and antlers and host guided hunts, both rifle and bow-and-arrow, for clients from all corners of the globe. Burton is active in the Kodiak Clean Lakes Project and the Kodiak District Soil and Water Conservation Programs.

In addition to her ranching activities, she serves as support staff for the Kodiak Rocket Launch Complex and also serves on the Kodiak Fair Board.

Outstanding Advisor

Charles Knight was recognized as the Outstanding Student Advisor for 2001 by the University of Alaska Fairbanks. Dr. Knight is an Associate Professor of Agronomy with the School of Agriculture and Land Resources Management. He has been with the university since 1978.

30 Years and Counting

Lola Oliver received a 30 year longevity award this spring. Although several staff members for the school and experiment station were recognized this year with longevity awards, Oliver was the school's only 30-year recipient. She is the supervisor of the Forest Soils Lab.

Chancellor's Recognition

Grant Matheke received the Chancellor's Recognition award for 2001. The award is given to a university employee each year for outstanding service in the university and community. Matheke is a research assistant at the Georgeson Botanical Garden. He is involved in children's outreach and classes at the garden, and is active in the university staff council.

School of Agriculture and
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