ADVANCES IN PLANT MATERIAL AND REVEGETATION TECHNOLOGY IN ALASKA

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ABSTRACT

The construction of the Trans Alaska Pipeline triggered the current research activity in reclamation for Alaska. However, since the pipeline, ideas associated with revegetation have changed. Continued oil development, renewed interest in surface and placer mining, as well as new federal, state and local regulations have caused applied research activities to address 'reclamation' as defined by regulations, which in some cases has precluded the use of "traditional" plant material and planting technology.

The Alaska Plant Materials Center continues to lead in applied research for cost-effective technology for use in reclamation and erosion control. Extending planting seasons through the use of dormant seedings, cost-effective and successful methods in willow planting, wetland and coastal restoration, are all priorities for the Plant Materials Center.

This paper outlines the present state of applied reclamation research being conducted by the Plant Materials Center. The paper will also present an overview based on 149 plot years of data on reclamation and erosion control species adapted to various regions of Alaska.

PREFACE

This paper will present a great deal of information in a small amount of space. It is a composite of individual reports available from the Alaska Plant Materials Center on request. The intent of the paper is to present the state of the Alaska Plant Materials Center's reclamation and revegetation research. This paper provides a general introduction to the Alaska Plant Materials Center and the methods employed to conduct the research. The paper will present general revegetation recommendations and techniques in willow planting, wetland restoration, and coastal revegetation.

INTRODUCTION

The Alaska Plant Materials Center (PMC) is a section of the Division of Agriculture within the Department of Natural Resources. In contrast to other PMCs, the Alaska center is fully state funded. The remainder of the centers in the United States are basically federally funded. Early attempts in establishing a federal Plant Materials Center in Alaska failed. The U.S. Department of Agriculture maintained that the centers at Pullman, Washington and Corvallis, Oregon could service the needs of Alaska.

Not to be discouraged by the lack of federal interest, the Alaska Legislature, at the urging of the University of Alaska, conservation groups, and farmers, prepared legislation for the establishment of the Alaska Plant Material Center. In 1972, Governor William Egan signed into law a bill creating the Alaska Plant Material Center. This legislation directed the Plant Materials Center to fulfill several more traditional agricultural responsibilities, and to develop plant varieties and techniques for revegetation and erosion control, and provide technical assistance to industry in the field of reclamation.

Following enactment, 285 acres were selected near Palmer for the Plant Materials Center. An additional 120 acres were acquired through a land exchange with the Matanuska-Susitna Borough in 1982. This gave the PMC 405 acres to accomplish its mandated duties, which not only includes revegetation oriented work, but also horicultural development, foundation seed production, and disease-free potato seed stock production.

In the spring of 1979, the Conservation Plant Project was established with one full time agronomist, and in 1982 a second agronomist was added. In 1987, the Conservation Plant Project was combined with the Foundation Seed Project to form the North Latitude Revegetation and Seed Project.

METHODS

Since the establishment of the Alaska Plant Materials Center (PMC) in 1972, native and introduced plants have been screened and evaluated for conservation uses.

The PMC follows seven basic steps to establish a resource of conservation plants for use in land reclamation, wildlife habitat improvement and erosion control. They are: 1) Define and anticipate conservation problems and establish priorities; 2) research and assemble candidate plant materials; 3) conduct initial evaluations; 4) establish small scale seed or vegetative increases; 5) advanced and final testing and field evaluation plantings; 6) establish large scale seed or vegetative increases; and, 7) release of a variety or cultivar (24).

The following describes each step in the evaluation process:

1. DEFINE AND ANTICIPATE CONSERVATION PROBLEMS AND ESTABLISH PRIORITIES.

The PMC anticipates plant materials needs in Alaska by becoming familiar with the regulations and laws regarding development and reclamation. The PMC also contacts regulatory agencies, land and resource management agencies, developers, and private groups for their input. For example, the Alaska Department of Fish and Game suggested that the PMC evaluate sedges, arrow grass (Triglochin maritimum), and Plantain (Plantago sp.) for waterfowl habitat improvement.

2. RESEARCH AND ASSEMBLE CANDIDATE PLANT MATERIALS.

Once a species has been identified for evaluation, the search for seed or vegetative materials begins. The plant material may be collected by PMC staff, interested parties, or the PMC may request plant material from the National Plant Materials Center, Regional Plant Introduction Centers, universities, agricultural experiment stations, and foreign countries.

3. INITIAL EVALUATION.

When the Center receives an adequate number of accessions of a species, preferably 20 to 40, initial evaluation plots are established. For herbaceous material, these plots are single row plantings, 20 feet in length for each accession, with usually 3 feet between accessions.

For woody material, the spacing is 8 to 10 feet between plants, 20 feet between rows and each row usually contains 10 plants.

The plots of herbaceous perennials are established and maintained for the seedling year plus three full years. Woody evaluations are set up for a minimum of 10 years. Annual and biennial species, as their name implies, are maintained for one and two years, respectively.

The evaluation process involves rating each accession against a "standard" if one is available. A standard is the best available variety of the species for Alaska. For instance, if Red fescue (Festuca rubra) were being evaluated, variety 'Arctared' would be used as the standard of comparison. See Figure 1 for list of standards. If no standard exists, comparisons are made against the best accession of the species tested in the past, or all the accessions of the species are rated against each other. A listing of accessions selected for advanced testing based on performances can be seen on Figure 2.

The rating systems can be tailored to the plant's intended use, or toward a specific characteristic. All evaluations rate: hardiness, vigor, seed production, and adaptation. Additional ratings can include attractiveness, leaf or flower color, and wildlife preference or palatability.

The total number of accessions under evaluation each year varies. From 1974 to date, in excess of 2,600 accessions have been evaluated.

4. SMALL-SCALE INCREASE.

When an accession under initial evaluation has exhibited superior qualities, seed or vegetative cuttings are collected and planted to produce the additional stock needed for further testing. Figure 3 shows the number of accessions selected for increase and advanced evaluation.

5. ADVANCED TESTING AND FIELD EVALUATION PLANTINGS.

This aspect of the program allows plant material to be evaluated in a wide range of edaphic and climatic conditions. See Figures 4 and 5 for location of test sites and typical plot layout. Some important species that may have failed at Palmer can thrive at other locations, and these plots provide the opportunity to evaluate the accessions' performance elsewhere. Basically, this phase revolves around two classes of plantings: 1) advanced evaluation and demonstration plots, and 2) mining and industrial evaluation plots.

Standards Of Comparison

Kentucky Bluegrass

'Nugget'
'Merion'
'Banff'
'Park'

'Sydsport'
'Fylking'
'Troy'

Other Bluegrasses

'Sherman'	Big Bluegrass
'Canbar'	Canby Bluegrass
'Rubans'	Canada Bluegrass
'Tundra'	Glaucous Bluegrass

Wheatgrasses

'Sodar'	Streambank Wheatgrass
'Nordan'	Crested Wheatgrass
'Fairway'	Crested Wheatgrass
'Summit'	Crested Wheatgrass
'Critana'	Thickspike Wheatgrass

Brome

'Polar'
'Manchar'
'Carlton'

Miscellaneous Grasses

'Engmo'	Timothy
'Climax'	
'Norcoast'	Bering Hairgrass
'Sourdough'	Bluejoint
—— Meadow Foxtail ——	
'Garrison'	Creeping Foxtail
'Alyeska'	Polar Grass

Fescues

'Arctared'	Red Fescue
'Boreal'	Red Fescue
'Pennlawn'	Red Fescue
'Highlight'	Sheep Fescue
'Covar'	Sheep Fescue
'Durar'	Hard Fescue

FIGURE 1.

Advance Test Species
Selected In 1981

Species	Common Name	Native Introduced	Source	Potential Use*
Agropyron subsecundum	Bearded Wheatgrass	N	Canada	FOR RVG (D)
A. subsecundum	Bearded Wheatgrass	N	Alaska	FOR RVG (D)
A. violaceum	Violet Wheatgrass	N	Alaska	RVG REC (D)
A. pectinforme	Crested Wheatgrass	I	USSR	FOR
A. boreal	Boreal Wheatgrass	N	Alaska	RVG
A. yukonense	Yukon Wheatgrass	N	Alaska	EC REC
Alopecurus geniculatus	Water Foxtail	I	USSR	RVG (W)
Artemisia tilesii	Tilesy Sage	N	Alaska	EC HAB
Beckmannia syzigachne	Sloughgrass	N	Alaska	REC HAB (W) FOR
Calamagrostis canadensis	Bluejoint	N	Alaska	REC HAB FOR
Calamagrostis inexpansa	Northern Reedgrass	N	Canada	RVG
Deschampsia caespitosa	Tufted Hairgrass	N	Alaska	EC REC (D) FOR
Elymus arenarius	Beach Wildrye	N	Norway	EC SP FOR REC
E. sibiricus	Siberian Wildrye	N?	USSR	FOR EC RVG REC? (D)
Festuca ovina	Sheep Fescue	I	USSR	RVG LDS
F. rubra	Red Fescue	N	USSR	RVG EC LDS
F. scabrella	Rough Fescue	I	Canada	RVG (D)
Poa angustifolia	Bluegrass	I	France	RVG (W)
P. ampla	Big Bluegrass	I	Canada	RVG LDS FOR
P. alpina	Alpine Bluegrass	N	Alaska	REC
P. glauca	Glaucous Bluegrass	N	Denmark	REC

* Key To Potential Uses

(D) - Dryland Use
(W) - Wetland Use
EC - Erosion Control
FOR - Forage
HAB - Habitat Enhancement
LDS - Landscape
RED - Reclamation
RVG - Revegetation
SP - Shore Protection

FIGURE 2.

Number of Accessions Selected for Increase and Advanced Evaluation

Plot	Number of Accessions Planted	Number Selected for Increase	Number Planted in Advance Test Plots
1979 grass plot	481	15	8
1979 forb plot	173	1	0
1980 grass plot	220	7	3
1980 forb plot	420	0	0
1982 grass plot	28	0	0
1982 forb plot	94	2	0
1983 grass plot	13	1	0
1983 forb plot	149	0	0
1983 wetland plot	111	1	0
1984 wetland plot	230	7	7
Woody plot[1]	402	7	7

[1] The numbers for this plot include all woody species evaluated since 1975.

Figure 3.

Advanced Evaluation and Demonstration Plots (AEDP) are established throughout Alaska for three purposes. The first is the advanced or final evaluation of plant materials that have performed well at the Palmer PMC for a period of at least three years. This offsite evaluation is important so that a plant's adaptability and range of suitability can be determined.

The second purpose is for demonstration plantings of plant material already recommended for the area. These recommendations are taken from The Revegetative Guide for Alaska. These plantings allow local people to view the varieties and allows for changes to be made in the Guide, if necessary.

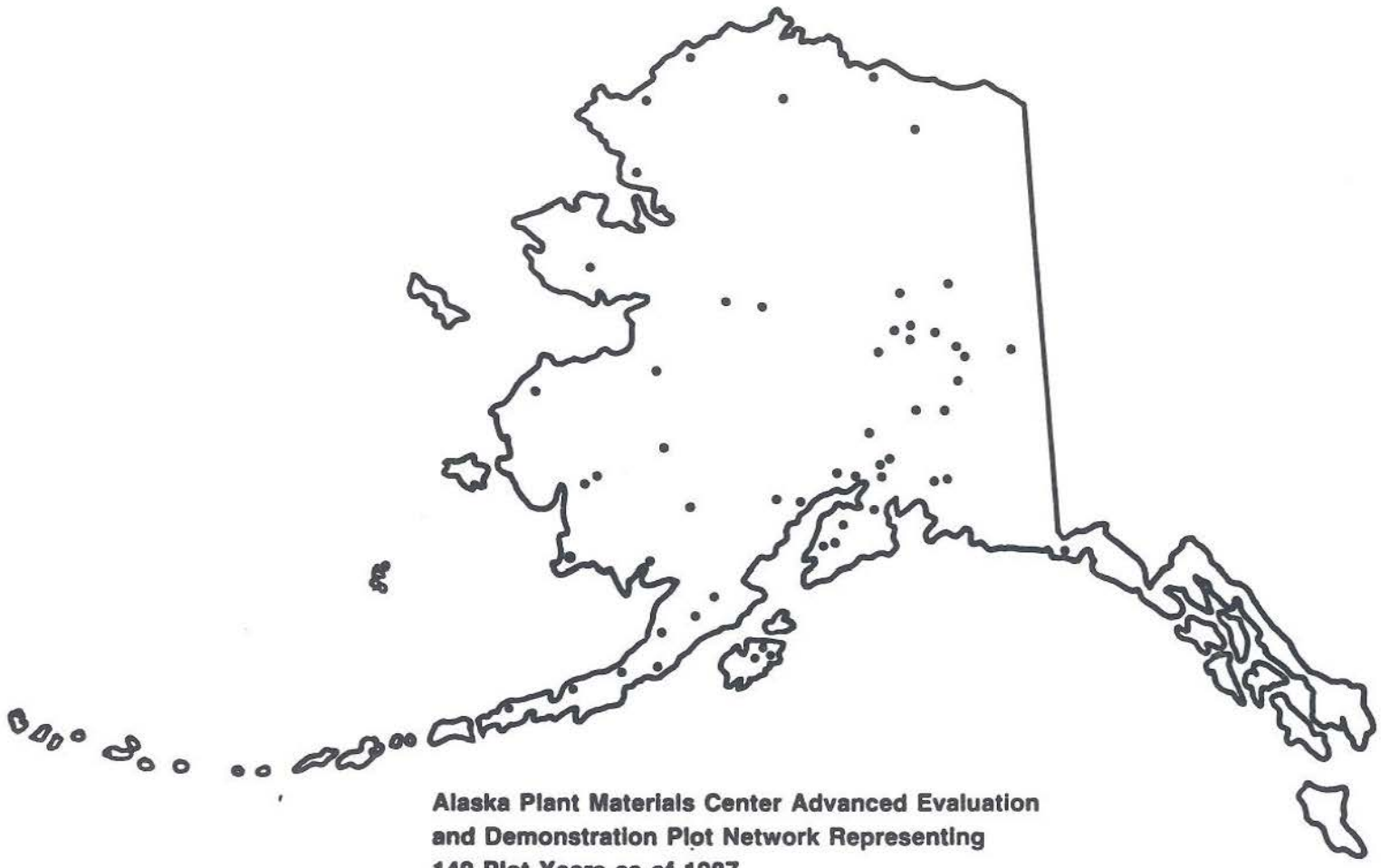
The third reason for AEDP is to provide a centralized area for local plantings by the cooperative Extension agents and other cooperators. This allows the agent to tailor the plot to local interests. The plots also give the agent a "classroom" where specific plant materials may be viewed and worked with by local farmers, students, and other groups interested in farming or gardening.

Mining and Industrial Evaluation Plots (MIEP) are usually designed for reclamation and/or erosion control and are located in diverse geographical and ecological locations. The plots are developed in a manner consistent with the clients intended final management practice, i.e., "fertilize it once and forget about it." The practice of minimal maintenance is generally necessary for industry to eliminate costly yearly maintenance programs. Therefore, the plots are established with minimal surface preparation and are only fertilized at the time of planting. The plantings are then evaluated for their ability to survive on these harsh sites with no maintenance, Topsoil is not used, and the plantings are made on the substrate that is expected to be available when reclamation occurs.

The MIEP also serves as an advanced evaluation of plant materials that have been selected at the PMC for their outstanding performance. In addition, the program also evaluates new techniques of planting and maintenance which could make the entire reclamation or erosion control process more cost effective.

The cooperator is allowed to set some of the parameters in the testing procedures, so that the test will provide useful data for the client's particular conditions. These plots also allow the PMC to make meaningful recommendations when similar conditions are encountered by someone other than the original client.

This class of evaluation plots probably provides the most important and useful information to the North Latitude Revegetation and Seed Project.



Alaska Plant Materials Center Advanced Evaluation and Demonstration Plot Network Representing 149 Plot Years as of 1987

FIGURE 4.

Typical Plot Layout

Nugget Kentucky Bluegrass	Merion Kentucky Bluegrass
Park Kentucky Bluegrass	Banff Kentucky Bluegrass
Sydsport Kentucky Bluegrass	Fylking Kentucky Bluegrass
Poa Ampla	Troy Kentucky Bluegrass
Sherman Big Bluegrass	Canbar Canby Bluegrass
Tundra Bluegrass	Reubans Canada Bluegrass
Poa Glauca T08867	Poa Alpina
Agropyron Subsecundum 371698	Sodar Streambank Wheatgrass
Nordan Crested Wheatgrass	Agropyron Subsecundum
Fairway Crested Wheatgrass	Agropyron Violaceum
Summit Crested Wheatgrass	Agropyron Boreal
Critana Thickspike Wheatgrass	Agropyron Yukonese
Fults Alkaligrass	Vantage Reed Canarygrass
Climax Timothy	Engmo Timothy
Elymus Arenarius	Elymus Sibiricus 34560
Elymus Sibiricus 1966	Elymus Sibiricus 2144
Norcoast Bering Hairgrass	Tufted Hairgrass
Sourdough Bluejoint	Calamagrostis Canadensis
Meadow Foxtail	Alopecurus Geniculatus
Garrison Creeping Foxtail	Arctared Red Fescue
Boreal Red Fescue	Festuca Scabrella
Beckmannia	Pennlawn Red Fescue
Durar Hard Fescue	Highlight Red Fescue
Covar Sheep Fescue	Manchar Smooth Brome
Alyeska	Carlton Smooth Brome
Tilesy Sage	Polar Brome

FIGURE 5.

6. LARGE-SCALE INCREASE.

Plant material will be grown from breeder blocks established and maintained at the PMC for foundation level production. The progeny from foundation production will be made available to private growers for further increase and distribution.

7. CULTIVAR RELEASE.

When an accession has proven to be superior through the evaluation process, and specific cultural and management techniques have been developed, the accession is released.

If it is agreed that the accession is superior and a need exists for the material, the accession is named, released, and promoted. All releases by the Alaska Plant Materials Center have been a cooperative effort with the Soil Conservation Service, USDA. Other agencies are invited to join in releases if they have interests in the species or intended uses.

RESULTS: RELEASES, RECOMMENDATIONS AND TECHNOLOGY ADVANCES

New Releases

The evaluation network established by the Alaska Plant Materials Center and the data collected from these plots has resulted in the release of two new grass cultivars and five willow cultivars. Within three years, an additional four grasses and one willow may be released.

From 1985 to date, the following cultivars have been released by the Alaska Plant Materials Center:

1.	'Egan' American Sloughgrass	*Beckmannia syzigachne*
2.	'Gruening' Alpine Bluegrass	*Poa alpina*
3.	'Roland' Pacific willow	*Salix lasiandra*
4.	'Wilson' Bebb willow	*Salix bebbiana*
5.	'Long' Barclay willow	*Salix barclayi*
6.	'Oliver' Barren Ground willow	*Salix brachycarpa*
7.	'Rhode' Feltleaf willow	*Salix alaxensis*

The following narratives describe each cultivar.

'Egan' American Sloughgrass: *Beckmannia syzigachne* is generally described as a light green grass with tufted culms native to cooler regions of North America. This species, which is usually associated with wet ground, can grow to 90 cm in height.

Many North American descriptions of American Sloughgrass, classify it as an annual. This has not, however, been the experience of the Alaska Plant Materials Center staff or other investigators working with the species in Alaska. The staff has found that 'Egan' American Sloughgrass, as well as the other accessions of Beckmannia syzigachne that have been tested, are short-lived perennials. Stands tend to decline after four to five years, and stand decline can be hastened by competition when more aggressive grass species become established in a Beckmannia stand.

'Egan' American Sloughgrass was tested in three initial screening trials at the Plant Materials Center at Palmer from 1974 to 1983. Additional offsite testing started in 1980, and to date, 'Egan' has been or is being tested at 26 sites in Alaska and the Yukon Territories of Canada.

Original seed increase occurred in 1979 and again in 1981. A one-acre increase plot was established in 1983.

Much has been written about the species' value as forage both in North America and Eurasia, but this application is, by law, not a priority for the Plant Materials Center. Seed of this accession has been supplied to interested farmers in Alaska, as well as the University of Alaska Agricultural and Forestry Experiment Station and South Dakota State University for forage research.

'Egan' American Sloughgrass is recommended for reclamation or erosion control plantings in seasonally wet areas such as ditches, streambanks, or fresh water shorelines. Because of the species' documented use by waterfowl, it is also recommended for plantings intended to benefit ducks and geese.

Based on offsite evaluations, species characteristics, and the natural range of the species, 'Egan' American Sloughgrass can be expected to perform satisfactorily between 60° north latitude, and the Arctic Circle. Evaluation is not complete beyond this region. Its value in Southeast Alaska has not yet been determined, and it has been found not to survive on Kodiak Island or the Aleutian Chain.

Although 'Egan' American Sloughgrass is less susceptible to seed shatter than any other accession of Beckmannia that were tested, seed shatter remains a moderate problem. In general, seed production, harvesting and cleaning of 'Egan' is easier than some native grasses in production at this time. Harvesting and cleaning can be accomplished with standard equipment.

Yields of clean seed off a one-acre plot are as follows: 1984 - 453 pounds, 1985 - 305 pounds. The lower yields from the 1985 crop resulted from shatter caused by a severe wind prior to harvest. Seed has generally been ready for harvest during the second or third week in August.

Because this species is most highly adapted to wet sites, seed production will be restricted to certified seed growers having the ability to irrigate production fields (Hulten 1968, Walsh 1974, Wright 1986a).

'Gruening' Alpine Bluegrass: Poa alpina is generally described as a perennial bunch grass that is native to arctic and boreal regions throughout most of Alaska with the exception of the Aleutian Islands and the southern portion of Southeast Alaska. Within North America, the species can be found from Alaska eastward throughout arctic and boreal Canada, and south to Quebec and northern Michigan. Further southern extension occurs in North America into Colorado and Utah at high elevations of the Continental Divide. Similar latitudinal and elevation extensions occur in Europe and Asia for this circumpolar species.

This non-rhizomatous species usually grows to a height of 10-40 centimeters with stout leaves 2-5 millimeters wide. This species forms a noticeable thatch of leaves from previous years' growth.

'Gruening' Alpine Bluegrass has been tested at the Alaska Plant Materials Center at Palmer since 1979. This accession has outperformed 24 other accessions of Poa alpina in all aspects, while under initial evaluation from 1979 through 1983.

Off-site evaluation began in 1983 at 18 sites throughout Alaska. Original seed increase occurred in 1981, and again in 1983 and 1984. In 1985, a quarter acre planting was established. The firt harvest from this plot occurred on July 7, 1986.

It is doubtful that this cultivar will have any value as an agricultural forage crop, although literature states that alpine bluegrass has been and is being used as a high elevation meadow forage by domestic livestock in North America and Europe.

Both the initial evaluation at Palmer and the off-site evaluations at other areas in Alaska, indicate that 'Gruening' Alpine Bluegrass will be used mainly for erosion control and reclamation ranging from streambanks to gravelly alpine sites. It is expected that this cultivar will replace a portion of the Kentucky Bluegrasses presently used for reclamation in some areas of Alaska. The low-growing nature and adaptation to gravelly sites indicate that this cultivar will also have use in highway revegetation where mowing becomes a concern.

Based on off-site evaluations, species characteristics, and the natural range of the species, 'Gruening' Alpine Bluegrass can be expected to perform satisfactorily from 60° north latitude to beyond the Arctic Circle and to high elevation areas above the timberline, south to 57° north latitude.

Within its range of adaptation, 'Gruening' Alpine Bluegrass can be expected to perform well under a wide range of conditions. This species is often found in dry, gravelly, or rocky sites, but testing has shown that this cultivar will also perform well on wetter sites with silty soils.

In general, seed production and characteristics of 'Gruening' Alpine Bluegrass will be similar to 'Nugget' Kentucky Bluegrass. Yields can be expected to be approximately 200 pounds per acre. Shatter can be severe if fields are not harvested at the first indication of maturity.

A major advantage of 'Gruening' Alpine Bluegrass, is also a potentially serious management problem. Because the seed of this cultivar is mature in the last week of June or the first week in July, and inflorescences appear simultaneously with spring recovery in early May, weed control with herbicides will be difficult, if not impossible. This trait may require the use of mechanical weed control until seed is harvested (Hulten 1968, Walsh 1974, Wright 1986b).

'Roland' Pacific willow: Salix lasiandra (Benth.), is a riparian species that inhabits river banks, alluvial deposits and wet meadows in boreal regions of Central Alaska, and Southeastern Alaska from Glacier Bay to the northern end of Lynn Canal. It also occurs in the Yukon Territory and eastward to the forests of Saskatchewan, and southward in the cordillera to California and New Mexico (Argus 1973).

Pacific willow is a tall shrub or small tree with grayish bark, growing to a height of six meters. The twigs of this attractive tree are shiny and somewhat stout. Leaves are thick, lance-shaped, 5-12.5 cm long and 12-25 mm wide with a very long point and a round base. They are dark, shiny green above and paler beneath (Viereck 1972).

The variety 'Roland' originated from a collection of softwood cuttings taken from a single shrub located at mile 2.4 Clark Wolverine Road near Palmer, Alaska in May, 1974. It has been under continual evaluation at the Alaska Plant Materials Center at Palmer, as Accession No. L161 or T7554, since collection. Off-site testing is being conducted at Fairbanks, Delta, Kenny Lake, and various mine sites throughout Alaska.

During the ten years of evaluation at the Palmer Plant Materials Center, this collection has not shown any sign of winter damage, or insect infestation. Similar results are being observed elsewhere.

This willow is expected to be used primarily for streambank restoration and erosion control, and secondarily for mine restoration. 'Roland' Pacific willow also has a great deal of potential as a home or commercial landscape variety. The landscape industry may become an important outlet for this variety.

Predation by moose can be a serious concern when growing willow in Alaska, however, no browsing has been noticed on 'Roland' at the Palmer Plant Materials Center. This is not a guarantee that browsing will not occur elsewhere.

'Roland' Pacific willow production will only be permitted by vegetative methods. The variety roots readily in any moist to wet rooting medium. When propagation methods include bottom heat at 18° - 20° C (65° - 68° F) and itermittent mist, root success approaches 100% (Wright 1985).

'Wilson' Bebb willow: Salix bebbiana Sarg. ranges widely in boreal and temperate regions. It can be found in Central Alaska, Eastern Alaske Peninsula, and Kodiak Island, but is absent in Pacific Coastal Alaska from Prince William Sound to Southeastern Alaska. It is also found throughout the southern half of the Yukon Territory, and the Northwest Territories of Canada. The range continues south to Arizona and New Mexico, and eastward across the northern tier of the United States. In the eastern hemisphere, it ranges in Eurasia, from the Kola Peninsula to Chukotsk Peninsula. Within this range, Bebb willow is usually encountered in riparian or mixed upland forests. It may form pure stands in wet lowland areas, but it can also be found on dry south-facing slopes and disturbed areas (Argus 1973).

This accession has been selected after being tested at Palmer and elsewhere in Alaska. It has carried the accession number L143 and T7536.

The original cuttings required to start this accession, were collected from a single plant in May 1974, near the Bodenburg Butte, south of Palmer.

Bebb willow can be described as a large shrub or a small, bushy tree .5 to 10 meters high. The leaves may be elliptic and pointed at both ends, or broadly oblanceolate or obovate-oval. The leaves range from 2.5 to 9 cm long and 10 to 25 mm wide. The leaf margins lack serations but can be wavy. The coloration of the leaves are dull green on top and gray underneath and are somewhat hairy on both sides. Slender yellowish to brown twigs branching at wide angles are characteristic of the species (Viereck 1972).

'Wilson' Bebb willow is a very dense, tall shrub making it ideal for windbreak and screening uses. If it is used in windbreak applications, 'Wilson' Bebb willow should be planted in multi-row, or multi-species arrangements. It is expected that 'Wilson' will be used for reclamation and restoration projects within the variety's range of adaptability. Bebb willow is listed as an important moose browse species in Interior Alaska. For this reason, 'Wilson' could be used for moose habitat enhancement.

'Wilson' Bebb willow propagation is restricted to vegetative methods. Bebb willow is more difficult to root than most other willows. In order to assure successful rooting, the best results have been obtained by using subsurface heat (70° to 75° F) in mist beds. A five second soak of Woods Rooting Compound (1.03IBA + .51 NAA) diluted with water 30:1 has provided the best results(Wright 1985).

'Long' Barclay willow: Salix barclayi Anderss., is found throughout southern coastal Alaska with the exception of the western Aleutian Islands. It's northern range extends to the Alaska Range and Tanana River. The eastern range runs through southern portions of the Yukon and Northwest Territories and continues south in the Rocky Mountains to British Columbia, Washington and Alberta (Argus 1973).

Within this range, Barclay willow can form large thickets along lake and river margins and on glacial moraines. It also ihabits sub-alpine and alpine slopes. It may occasionally be found in muskegs.

The accession was collected on May 28, 1974 at mile 1.9 Clark Wolverine Road near Palmer, Alaska. Hardwood cuttings were taken from a single plant growing on a disturbed roadside. The parent plant was heavily browsed by moose. The accession was assigned a local number of L171 and a national number of T07557.

'Long' has performed well at the Plant Materials Center, and has had no problems with disease or pests since planting in 1975.

Barclay willow is a large shrub that may take on tree-like appearances. This species is characterized by heavy, dense branching. Typically, it grows to two meters in height, but shrubs have been found up to six meters tall. The leaves are broad, elliptical or ovate, ranging from 2-7.5 cm long and 1-3 cm wide. Leaf margins will vary from serrate to entire. The upper surfaces of the leaves are yellowish green, occasionally with short, red hairs on the mid rib. The lower surfaces are whitish. The mature twigs are reddish-brown and hairless (Viereck 1972).

'Long' Barclay willow should become an important reclamation and erosion control variety throughout Southcentral Alaska. The dense growth form of 'Long' Barclay willow is sufficient to merit its use as a windbreak or shelterbelt variety.

Propagation of 'Long' Barclay willow will be restricted to vegetatve methods. The actual propagation of Barclay willow is easily accomplished by placing hardwood cuttings in any suitable rooting medium with intermittent mist. No additional propagation techniques are required (Wright 1985).

'Oliver' Barren ground willow: Salix brachycarpa Nutt. ssp. niphoclada (Rydb.) Argus, is found throughout central Alaska, the Alaska Range, arctic Alaska, and parts of the Alaska Peninsula, and in the Yukon Territory south to northern British Columbia, and eastward throughout the Northwest Territories to Hudson Bay. Within this range, Barren ground willow occupies different niches. In the arctic, it can be found in shrub tundra and along streambanks. In mountainous regions, it is found on dry alpine and limestone talus slopes. In boreal areas, it occurs as a pioneer species on alluvial and glacial deposits (Argus 1973).

This accession has been tested as L104 and T07542. 'Oliver' parent stock was collected by the Matanuska River bridge, south of Palmer, in April 1974. It has been evaluated at the Plant Materials Center since it was collected. Additional testing has occurred at Delta, Fairbanks and mine sites in Southcentral and Interior Alaska.

Barren ground willow is a gray-appearing, low-growing shrub which can grow to two meters in protected areas. The leaves of this species are variable, usually obovate to lanceolate, and are short and pointed with the upper surfaces being green, and thinly hairy, while the lower sides are whitish and more densely hairy. Leaves measure 25-40 mm in length and 5-10 mm wide. Twigs are thin and reddish-brown and covered with dense hairs when young. The catkins develop with the leaves and persist throughout the summer and sometimes through the following winter (Viereck 1972).

'Oliver' Barren ground willow has performed well in windbreaks and can be used in a multi-row windbreak or shelter belt providing low to mid-height protection.

'Oliver' has also performed well on drastically disturbed soils characteristic of mining disturbances. This performance indicates the variety's potential for use in reclamation projects.

Variety Selection Chart

Variety/Species	Region				
	South Central	Kenai Pen. & Kodiak	Interior (S. of Yukon R.)	Western	South-Eastern
'Roland' Pacific willow	X	?	X	No	?
'Wilson' Bebb willow	X	X	X	X	?
'Long' Barclay willow	X	X	X	?	X
'Rhode' Feltleaf willow	X	X	X	?	X
'Oliver' Barren ground willow	X	No	X	No	No

FIGURE 6.

'Oliver Barren ground willow propagation will be restricted to vegetative methods. Hardwood cuttings placed in moist rooting medium, usually sand, provide very good results. To enhance rooting, it is suggested that the cuttings be subjected to intermittent mist and bottom heat at 18° to 20° C (65° to 68° F) while in sand. A weak application of IBA (.1% in Talc) is optional, but does not appear to be necessary.

'Rhode' Feltleaf willow: Salix alaxensis (Andress.) Cov., is a species that can be found in arctic, alpine and boreal habitats throughout Alaska, with the exception of most of the Aleutian Islands, some Bering Sea islands, and southeastern Alaska south of Glacier Bay. It also occurs throughout the Yukon Territory, British Columbia and eastward across the Canadian arctic, and south in the Rocky Mountains to Jasper National Park. Feltleaf willow is also found in Asia from the Yanisei River, eastward to the Chukotsk Peninsula and southward to Lake Baikal (Argus 1973).

Within this range, Feltleaf willow can be found growing on gravel bars, along river and streambanks, lake terraces and alpine meadows.

This accession was collected from a single parent plant near Palmer in April 1974, and has been under evaluation as accession L-113 (or T07512) since that date.

Feltleaf willow is a shrub or small tree six to nine meters high. The species, when growing in exposed areas, may become dwarfed or prostrate (Hulten, 1968). Young twigs are woolly becoming smooth and shiny with age. Leaves are oblanceolate to elliptic with dense, white felt underneath. The upper surface of the leaves is dull green and hairless (Viereck 1972).

'Rhode' has exhibited vigorous annual growth and exceptional resistance to cold and drought.

'Rhode' has performed well at various mines in southcentral and interior Alaska. In addition, moose often select this variety over other accessions of the same species, which makes 'Rhode' an excellent candidate for habitat enhancement as well as mine reclamation.

The fast growth rate also makes this variety suitable for incorporation into windbreaks in Alaska.

All propagation of 'Rhode' is restricted to vegetative methods. Feltleaf willow's preformed root initials make it exceptionally easy to propagate from hardwood cuttings. 'Rhode' requires no special treatment other than moist rooting medium to achieve nearly 100% rooting (Wright 1985).

Regional Recommendations

In addition to the new plant materials released for producton, the plot network has allowed a base of knowledge to be developed for revegetative recommendations. This systematic evaluation network has allowed for ground truthing and refining past standard recommendations and developing new recommendations.

The basic recommendations developed in this report do not include 'Kenai' Polar grass, Arctagrosis latifolia, or 'Nortran' Tufted Hairgrass, Deschampsia caespitosa. These two cultivars have been recently developed by Dr. Mitchell of the University of Alaska. 'Nortran' will probably replace or supplement 'Norcoast' Bering Hairgrass as a recommended variety for interior Alaska recommendations. 'Kenai' Polar grass will in some cases, replace or supplement 'Alyeska' Polar grass in some revegetation regions of Alaska. Revegetation regions are outlined in Figure 7.

Figures 8, 9, 10, 11 and 12 represent the findings (or lack of findings for Figure 13) from the evaluation network (Moore 1986a, 1986b, Wright 1986c, 1987a, 1987b, 1987c, 1987d, 1987e, 1988a, 1988b, 1988c, 1988d, Wright - Moore 1986).

As with all general regional revegetation recommendations, the Alaska Plant Materials Center does not suggest that these be followed without site specific refinement.

Specific site recommendations can be developed with specific information on soil conditions (texture, pH, and moisture), exposure and other microclimatic factors, i.e., elevation.

These factors would allow specific seed mixtures to be recommended using adapted varieties and secondary cultivars in specific proportions. The same applies to the willow variety selection chart presented in Figure 6.

Revegetation Regions of Alaska

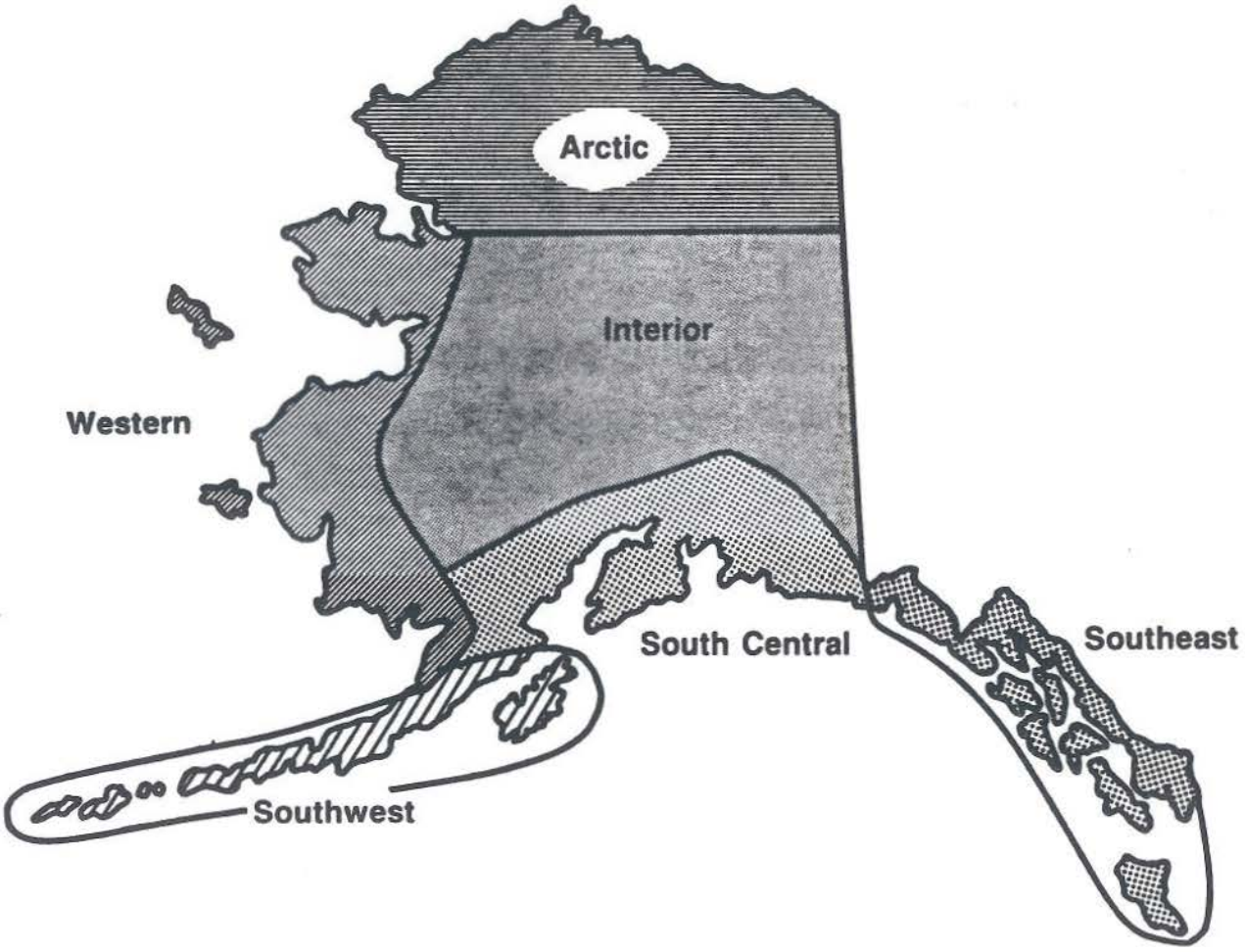
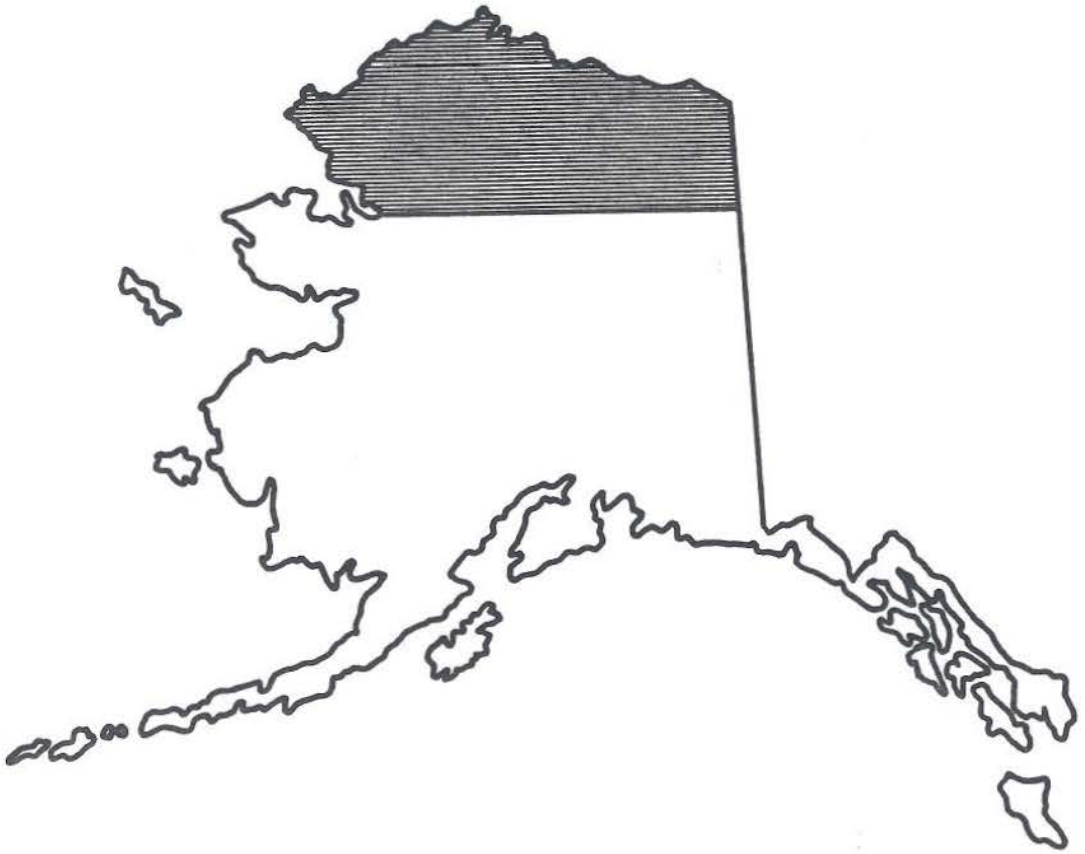


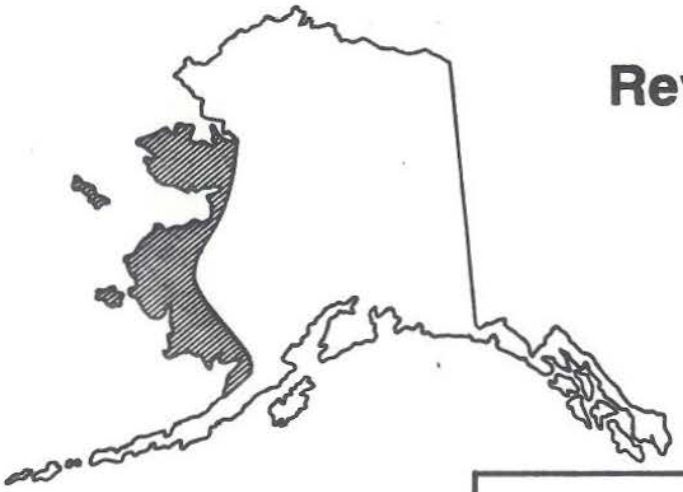
FIGURE 7.

Arctic Region
Revegetation Recommendations



Cultivars Adapted For Use In Arctic Alaska
'Tundra' Glaucous Bluegrass
'Alyeska' Polar grass
'Arctared' Red fescue
'Egan' American Sloughgrass
'Gruening' Alpine Bluegrass
Secondary Cultivars And Collections Yet To Be Released
'Nugget' Kentucky Bluegrass
'Norcoast' Bering hairgrass
'Sourdough' Blue joint
'?' Violet wheatgrass

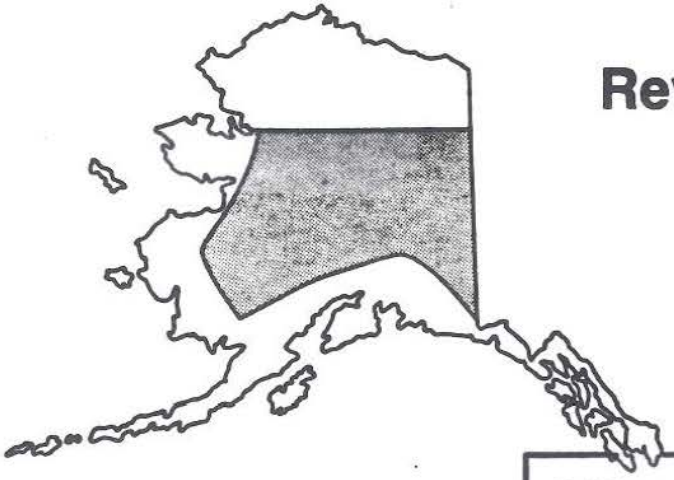
FIGURE 8.



Western Region
Revegetation Recommendations

Cultivars Adapted For Use In Western Alaska	Secondary Cultivars And Collections Yet To Be Released
'Norcoast' Bering Hairgrass	'Merion' } — Kentucky Bluegrass
'Nugget' Kentucky Bluegrass	'Sydsport' } — Kentucky Bluegrass
'Tundra' Glaucous Bluegrass	'Highligh' Sheep Fescue
'Sourdough' Bluejoint	'Manchar' Smooth brome
'Arctared' } — Red Fescue	'Vantage' Reed Canary Grass
'Boreal' } — Red Fescue	'?' Rough Fescue
'Egan' American Sloughgrass	'?' Tilesy Sage
'Alyeska' Polargrass	'?' Big Bluegrass
'Polar' Brome	'?' Beach Wildrye

FIGURE 9.

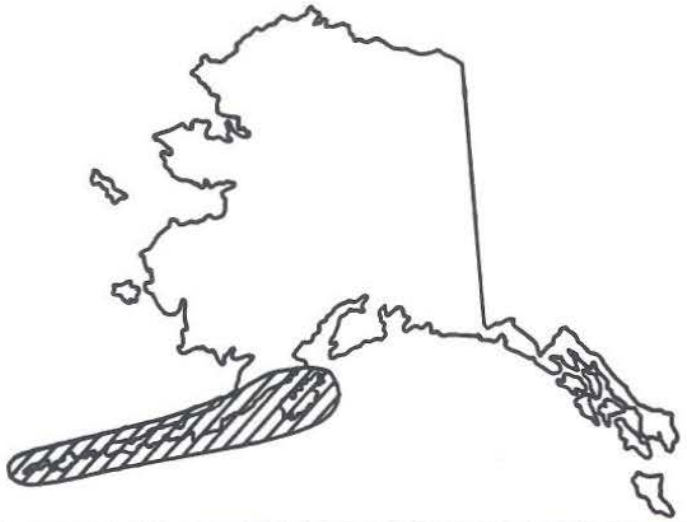


Interior Region
Revegetation Recommendations

Cultivars Adapted For Use In Interior Alaska	Secondary Cultivars And Collections Yet To Be Released
'Nugget' / 'Park' — Kentucky Bluegrass	'Kamalinski 7' Siberian Wildrye
'Tundra' Glaucous Bluegrass	'Merion' / 'Sydsport' / 'Fylking' — Kentucky Bluegrass
'Gruening' Alpine Bluegrass	
'Engmo' Timothy	—— Meadow Foxtail ——
'Norcoast' Bering Hairgrass	'?' Big Bluegrass
'Sourdough' Bluejoint	'?' Violet Wheatgrass
'Arctared' / 'Boreal' — Red Fescue	'?' Boreal Wheatgrass
'Egan' American Sloughgrass	'?' Rough Fescue
'Manchar' Smooth Brome	'?' Tilesy Sage
'Polar' Brome	

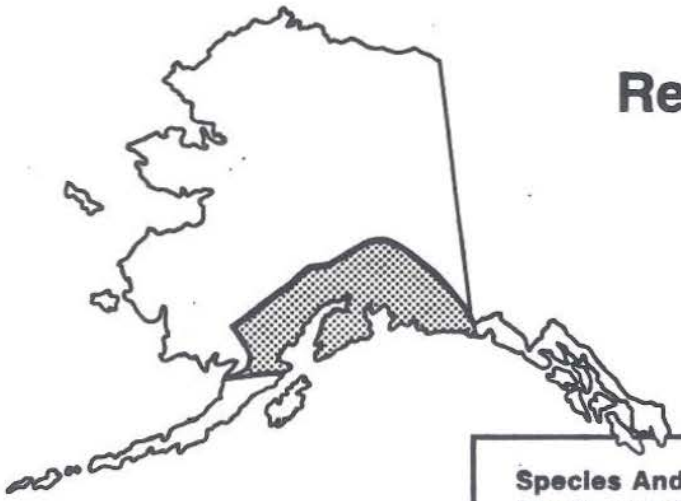
FIGURE 10.

Southwestern Region
Revegetation Recommendations



Cultivars Adapted For Use In Southwest Alaska	Secondary Cultivars And Collections Yet To Be Released	Preferred Cultivars For Alpine Areas In Southwest Alaska
'Norcoast' Bering Hairgrass	'Arctared' Red Fescue	'Arctared' } Red fescue 'Boreal' }
'Vantage' Reed Canary Grass	'Fylking' Kentucky Bluegrass	'Gruening' Alpine Bluegrass
'Boreal' } — Red Fescue 'Pennlawn' }	—— Meadow Foxtail ——	'Norcoast' Bering Hairgrass
'Nugget' } — Kentucky Bluegrass 'Merion' }	'?' Tilesy Sage	'Sourdough' Bluejoint
'Sourdough' Bluejoint	'?' Beach Wildrye	
	'?' Rough Fescue	

FIGURE 11.

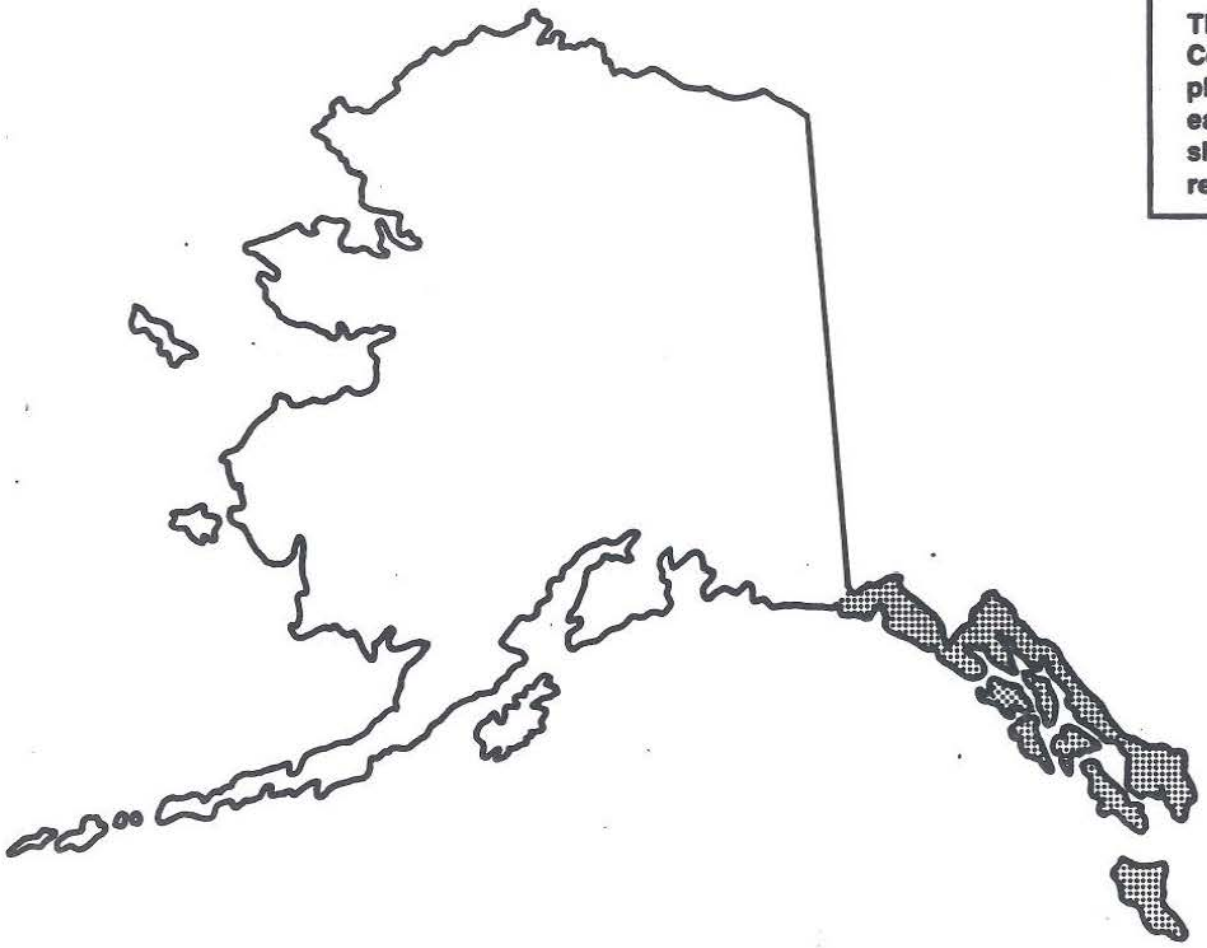


Southcentral Region
Revegetation Recommendations

Species And Cultivars Adapted For Use In Soutcentral Alaska	Secondary Choices And Collections Yet To Be Released
'Nugget' Kentucky Bluegrass	'Park', 'Merion', 'Sydsport', 'Fylking' — Kentucky Bluegrass
'Gruening' Alpine Bluegrass	'?' Glaucous Bluegrass
'Engmo' Timothy	'Kamalinski 7' Siberian wildrye
'Norcoast' Bering hairgrass	—— Meadow foxtail——
'Sourdough' Bluejoint	'?' Rough Fescue
'Arctared', 'Boreal', 'Pennlawn' — Red Fescue	'Highlight' Sheep Fescue
'Manchar' Smooth Brome	'?' Tilesy Sage
'Alyeska' Polar grass	
'Polar' Brome	
'Egan' American Sloughrass	

FIGURE 12.

Southeastern Region
Revegetation Recommendations



The Alaska Plant Materials Center has not evaluated plant material in Southeast Alaska. Local knowledge should be utilized, for revegetation specifications.

FIGURE 13.

Commercial availability of native cultivars will always be a factor in developing recommendations. The seed industry in Alaska is still in its infancy, and a degree of reluctance to grow new cultivars still exists in the commercial sector. This causes somewhat of a chicken and egg situation. The growers are reluctant to grow potentially valuable cultivars until it is in demand and users are reluctant to recommend or demand cultivars until they are commercially available.

The listing on Figure 14 identifies commercially available native seed for Alaska and estimates availability dates.

COMMERCIALLY AVAILABLE NATIVE SEED

1988

'ARCTARED'	Red Fescue	*Festuca rubra*
'NORCOAST'	Bering Hairgrass	*Deschampsia beringensis*
'ALYESKA'	Polar Grass	*Arctagrostis latifolia*
'TUNDRA'	Glaucous Bluegrass	*Poa glauca*
'NUGGET'	Kentucky Bluegrass	*Poa pratensis*

1989

'EGAN'	American Sloughgrass	*Bechmannia syzigachne*
'GRUENING'	Alpine Bluegrass	*Poa alpina*

1990 and Later

'SOURDOUGH'	Bluejoint	*Calamagrostis canadensis*
'NORTRAN'	Tufted Hairgrass	*Deschampsia caespitosa*
--	Tilesy Sage	*Artemesia tilesii*
--	Beach Wildrye	*Elymus arenarius*
'KENAI'	Polar grass	*Arctagrostis latifolia*

Figure 14.

WILLOW PLANTING TECHNIQUES

The Plant Materials Center has released for commercial use, five cultivars of willow from five species. Commercial production may not substantially reduce the cost of planting willow on a large scale, but it will make regional proven material available. Prior to the present commercial production, the only source of willow was the native stands or a very limited supply of seedlings.

Out of all the methods used in Alaskan reclamation, willow planting is, by far, the most maligned. The only large scale use of willow by industry has been the plantings conducted on the Trans Alaska Pipeline. A decade has past since Alyeska's attempts and methods have improved.

The procedures used by Alyeska during the first year of willow plantings relied on cuttings rooted in "Jiffy Pots." This method was dropped during the second year and direct planting of dormant sprigs was attempted. Also, Alyeska selected sites more suitable for willow establishment than those selected by the regulatory agencies. The dormant cuttings proved to be much more successful, especially when they were not planted in upland rip-rap pits.

In 1979, the Plant Materials Center started investigating improved methods to conduct willow plantings. These methods not only needed to produce a high degree of success, but also needed to be cost-effective. Willow planting had to become an effective revegetation technique.

The Plant Materials Center started with 8-10 inch dormant, unrooted cuttings. This method has proven successful, provided grass competition is not significant and adequate moisture is available. Dormant, unrooted cutting provides an advantage as being easy to prepare and plant as well as being low in cost.

The disadvantages of this method are: 1) the cuttings must be kept in cold storage until planted, 2) they must not be permitted to dry out or become excessively wet during storage, 3) they have a lower survival rate than other methods, and 4) requires planting sites with adequate soil moisture.

The next method that was adopted by the Plant Materials Center, was bundling of dormant material. This method has also been referred to as wattling. This technique involved tying four-foot long, dormant willow branches in bundles 4-6 inches in diameter. The bundles are then planted horizontally to a depth three fourths of the bundle's diameter. This method has proven to be more able to compete with grass. The prime advantage to this technique is the physical block that the bundle mass provides in erosion control. Bundles also provide quick linear cover.

The disadvantages are the same as for dormant cuttings except soil moisture is not as critical. This method does require more plant material than any other method.

The use of container grown cuttings is probably the most effective method to establish willow. The method is more costly than using dormant material. It also requires more care in planting.

The advantages are obvious. The plants are established and growing when planted. The container material is also more suited to dry sites. The age of the planting stock can range from material rooted in the year of planting to 1 - 0 and older stock (Moore etal 1986, Wright - Moore 1986).

More efficient methods of planting need to be developed before large-scale plantings are likely in Alaska. This is being explored by the Plant Materials Center at this time.

DORMANT SEEDING VS. TRADITIONAL SPRING SEEDINGS OF GRASSES

The Alaska Plant Materials Center is actively attempting to determine if dormant seeding is a viable procedure in Alaska. Because of Alaska's long winters, heavy snowfall, and rapid melt, it has been the feeling of many in Alaska that dormant seedings are not practical.

This has forced all revegetation activities to occur in a relatively short "seeding window." The "seeding window" is the period allowed for seedling establishment prior to winter. In the Arctic, this could have forced all seedings into a period as short as 20 - 30 days. By permitting dormant seedings, the period to seed would be greatly increased. This would, of course, allow greater flexability in scheduling revegetation.

By permitting dormant seedings, the period to seed would be greatly increased. This would, of course, allow greater flexability in scheduling revegetation.

Recent findings by the Plant Materials Center at the Kuparuk Oil field and the Beluga Coal fields, has suggested that dormant seedings are possible. The critical factor in dormant seedings still remains to be slope and spring run-off. On level ground, as was used in the Kuparuk plots and the Beluga plots, no difference in overall success was noted. However, in the Kuparuk plots, prolonged dormancy in some of the spring seeded grasses occurred. In fact, some accessions did not break dormancy for one year. The dormant seedings produced measureable stands the spring following planting. A slight increase in vigor was noted for the dormant seedings (Wright 1986c, Wright 1987e).

WETLAND REVEGETATION AND RESTORATION

The importance of wetlands in Alaska cannot be understated. In addition to the ecological importance of these areas the regulations developed to protect them can be overwhelming.

The North Latitude Revegetation and Seed Project is the only agency in State government attempting to solve revegetation problems associated with revegetation of wetlands.

The Plant Materials Center has worked with the Alaska Department of Fish and Game and Ducks Unlimited in the revegetation of two waterfowl habitat enhancement projects. These projects at Palmer and Fairbanks have demonstrated the effectiveness of new wetland cultivars developed in Alaska; primarily 'Egan' American Sloughgrass and 'Norcoast' Bering Hairgrass.

Another demonstration project that was designed to revegetate a wetland area was the Bethel Small Boat Harbor. This project, initiated in 1984 in cooperation with the Corps of Engineers, proved the adaptability of 'Egan' American Sloughgrass and 'Norcoast' Bering Hairgrass to the Bethel region of western Alaska (Moore 1986a).

Presently, the North Latitude Revegetation and Seed Project, in cooperation with ARCO Alaska, is attempting to determine the potential of successfully establishing Arctic pendant grass, Arctophila fulva, in the Arctic. Arctic pendant grass is an emergent grass species usually associated with lakes and ponds in the Arctic.

Initial findings after the third year of the investigations, have been inconclusive as to success and economic feasibility of transplanting arctic pendant grass (Moore - Wright, in press).

This project will continue for at least one more year before it is determined whether or not to proceed with further studies.

COASTAL RESTORATION AND EROSION CONTROL

The State of Alaska has more coastal shoreline than the remainder of the United States combined. Therefore, coastal revegetation merits study.

The first major project involving coastal revegetation and erosion control in Alaska occurred on Shemya Air Force Base.

Shemya Air Force Base is located approximately 1,500 air miles south of Anchorage, on Shemya Island in the last group of islands at the western extreme of the Aleutian Island chain. Shemya Island is roughly four miles east to west and two miles north to south.

Climatically, the island is classified as maritime. Seasonal variations in temperature are small. Mean daily temperatures in January are approximately 31° F, and in July they are approximately 45° F. Average annual precipitation is slightly less than 28 inches. The most obvious and overriding climatic factor is wind and fog. Severe winds, at times in excess of 70 knots, can lash the island. The most significant winds occur during late fall, winter and early spring.

In 1987, construction adjacent to the runway at Shemya Air Force Base, removed existing dunes and vegetation and exposed 27 acres of erodable sand to the winds. Transported sand would cause aircraft maintenance and safety problems.

Previous attempts to revegetate the Lateral Clear Zone failed. In 1987, the U. S. Army Corps of Engineers Alaska District and the Alaska Plant Materials Center, Department of Natural Resources, designed a revegetation and erosion control project to prevent erosion on the area planned for construction in 1987.

Based on initial studies in 1986, it was determined that Beach wildrye Elymus arenarius L. (also referred to as E. mollis Trin.) could be established using transplanted sprigs (Wright 1986d).

The revegetation plan also called for seeding with the following grasses:

Cultivar	Common Name	% By Weight
'Norcoast'	Bering Hairgrass	40%
'Pennlawn'	Red Fescue	25%
'Boreal'	Red Fescue	30%
	Annual Ryegrass	3%

The seed mix was applied at a rate of 60 pounds per acre.

Prior to sprigging, the area was fertilized at a rate of 500 pounds per acre of 14-30-14. A supplemental application of 75 pounds per acre of 34-0-0 occurred 60 days after seeding.

The contractor was given a choice of two chemical soil stabilizers, Coherex and Soil Seal to apply for temporary erosion control. Both stabilizers were proven to have no adverse effect on Beach wildrye sprigs.

In May 1987, the contractor, aided by the Alaska Plant Materials Center, started the revegetation project. Minor modifications to the available construction equipment, allowed the methods for harvest and planting to be simplified.

Production rate for planting one acre (20,000 sprigs) was 60 man hours. The ideal crew consisted of three diggers and three planters.

In September 1987, the area was evaluated. Twelve 50-meter transects indicated that 90% of the Beach wildrye sprigs had become established.

Overall ground cover was 80-85%, 41% of which was Beach wildrye, 43% seeded perennial grasses, 15% annual rye grass, and <1% invading native broadleaf species. The vigor of the vegetation was good to excellent.

Stand diversity was higher than expected. Propagules from broadleaf native species had been introduced when a thin (2-4 inches) veneer of peat had been applied to the area as a temporary solution to reduce wind erosion.

Data indicated that established vegetation consisted of 75% perennial grasses (seeded and sprigged), 18% annual grasses, and 2% invading broadleaf species (Wright et.al. 1987d).

The project was the first major attempt to establish Beach wildrye in Alaska. The success of the project indicates that it is a viable reclamation and erosion control method.

Future projects would be able to reduce costs by reducing the number of sprigs per acre, reducing the amount of seed used, and possibly eliminating the use of soil stabilizers. Both the elimination or the reduction of any component must be weighed against 1) consequences of a partial failure, 2) intent of the project, or 3) value of what is to be restored or protected.

ACKNOWLEDGEMENT

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Last, but by far not least, the Plant Materials Center wishes to thank ARCO Alaska for the excellent graphic slides and figures used in the presentation and paper.

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