

**Final Report of Data and Observations
Obtained From the Adak Naval Air Station
Evaluation Plot Network**

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Introduction:

The North Latitude Revegetation and Seed Project at the Alaska Plant Materials Center (PMC), in the Alaska Department of Natural Resources, is responsible for developing new plant varieties (cultivars) for land reclamation, habitat enhancement, and erosion control. In addition to the development of new plant varieties, this project also is responsible for developing techniques for erosion control and reclamation, and to provide technical assistance to industry and government so that the techniques are used effectively. In order to accomplish these goals, it is beneficial for the PMC to work with other agencies. Resource extraction industries and components of the armed forces usually have disturbances on which these new varieties or techniques can be tested.

In the spring of 1988, the U. S. Navy requested that the PMC assist the Soil Conservation Service in developing a Natural Resources Management Plan for Adak Naval Air Station. The role of the PMC was to select species of commercially available plant species suitable for reclamation, erosion control and landscaping. Additionally, the PMC was charged with refining techniques for using Beach wildrye (Elymus mollis) on Adak.

Purpose:

Adak Naval Air Station needed answers for the following; 1) what species and varieties would perform best in future revegetation and landscape programs; 2) would native willow species perform on Adak; 3) could abandoned military installations be successfully restored; and, 4) how could the constant blowing sand problems be solved?

History & Site Description:

With the previous questions in mind, a series of sites were selected on Adak NAS property. These sites were representative of existing and future areas which will require revegetation.

During May of 1988, 18 grass plots were established. Seven of the plots were advanced evaluation plots similar to the plots planted throughout Alaska (Figure 1). Six of these were planted on beach sand adjacent to a Navy structure. The other plot was established on a portion of regraded solid waste disposal site. Four abandoned quonset hut sites were also used for evaluation plots to determine the effectiveness of a seed mix used elsewhere in the Aleutian Islands. This mix was also seeded on plots located in a gravel pit (Tuxedo Hill Quarry) and the landfill site.

A major portion of the study on Adak centered on the use and management of Beach wildrye (Elymus mollis). These studies accounted for an additional five plots.

In addition to the grass plots, one woody planting of willow was established in May, 1988.

Plot evaluations occurred on September 14, 1988; May 23, 1989; September 13, 1989; July 10, 1990 and September 21, 1990.

The only plot not evaluated for the entire study period was the Tuxedo Hill quarry site. This plot was destroyed by construction activity.

Methods:

Each Advanced Evaluation Plot (Figure 1), was hand-seeded with pre-measured amounts of seed. The seeding rates of each block were approximately 40 pounds per acre. Following seeding, the plots were fertilized with 20-20-10 fertilizer at a rate of 500 pounds per acre (100 pounds actual nitrogen, 100 pounds actual phosphorus, and 50 pounds actual potash).

After each plot was seeded and fertilized, the area was raked by hand to incorporate the seed and fertilizer. In addition to the above treatment, one plot at the beach sand site was limed at a rate of 500 pounds per acre. This was done at the request of the SCS in spite of the fact that the pH at the site was 6.8.

Typical Plot Layout

←-----> 7.5' ←----->	
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	'Gruening' Alpine Bluegrass
Agropyron subsecundum 371698	Sodar Streambank Wheatgrass
Nordan Crested Wheatgrass	Agropyron subsecundum Canada
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 345600
Nortran Tufted Hairgrass	Tilesey Sage
Norcoast Bering Hairgrass	Not Planted
Sourdough Bluejoint	Calamagrostis canadensis Delta
Meadow Foxtail	Alopecurus geniculatus
Garrison Creeping Foxtail	Arctared Red Fescue
Boreal Red Fescue	Festuca scabrella
'Egan' American Sloughgrass	Pennlawn Red Fescue
Durar Hard Fescue	Highlight Red Fescue
Covar Sheep Fescue	Manchar Smooth Brome
Alyeska	Carlton Smooth Brome

Figure 1. Typical Plot Layout

The advanced evaluation plots are evaluated at least once a year. The accessions are rated for vigor, percent stand, and numerous other hardiness and disease-resistant related characteristics. However, we have found that vigor and percent stand give a reliable indication of how the different accessions compare with each other. The next page is an example of the evaluation sheets that will be presented in this report (Figure 2). The following numbers, followed by brief explanations, correspond to numbers on the example evaluation sheet:

1. Location and title of evaluation plot.
2. Number of evaluation blocks. This number may range from 1 to 3 blocks.
3. Year of Record--the year that evaluation data was collected.
4. Vigor--this number can range from 1 to 9. One is best and 9 is the worst rating. If possible, this rating is determined by comparison with other accessions of the same species. The rating is based on color, height, health, flowering and/or seed production and on the evaluator's knowledge of the plant and its expected performance. If more than one block is planted, this number will be an average of the ratings for each block.
5. Percent Stand--this number represents the percentage of the ground that is covered by the accession. Only live plant material is included, litter from previous years' growth and other species are not included. If more than one block is planted, this number will be an average of the ratings for each block.
6. The accession that is being rated. The accession is identified by its varietal and common name or its common name and its accession number.

1	2 # of Blocks	4	5						
1	6								1
2	'Merion' Kentucky Bluegrass								2
3	'Banff' Kentucky Bluegrass								3
4	'Park' Kentucky Bluegrass								4
5	etc.								5
6									6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
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15									15
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50									50
51									51
52									52

Figure 2. Sample Advanced Evaluation Page.

Advanced Evaluation Plot Results:

At the conclusion of the evaluation period, September, 1990, the data compiled was analyzed (Figures 3 through 9).

The seven plots were divided into two groups based on location and substrate type. Group 1 consisted of six beach sand plots and Group 2 consists of the plot at the landfill site.

Group 1 represents the loose, sandy conditions found at lower elevation sites on the air station. At this site, red fescue, hairgrass and a few bluegrasses predominated. The best performance was recorded for Rough Fescue (*Festuca scabrella*) PI 236849. Unfortunately, no commercial source of seed exists for this species. 'Boreal' Red Fescue and 'Norcoast' Bering Hairgrass performed the best of any commercial grasses. Other commercial varieties that performed well were 'Pennlawn' Red Fescue, 'Arctared' Red Fescue, 'Caiggluk' Tilesy Sage, "Merion' Kentucky Bluegrass and 'Nugget' Kentucky Bluegrass.

The landfill site, a more upland site consisting of silty sand, yielded slightly different results than the beach sand plots. More accessions survived and different accessions performed well. Equally good performance was recorded for 'Merion' Kentucky Bluegrass, Glaucous Bluegrass T08867, 'Gruening' Alpine Bluegrass, 'Nortran' Tufted Hairgrass, 'Norcoast' Bering Hairgrass, 'Boreal' and 'Pennlawn' Red Fescue and Rough Fescue PI236849. With the exception of Rough Fescue and Glaucous Bluegrass T08867, all accessions are commercially available. 'Nugget' Kentucky Bluegrass, Beach Wildrye 345978 and 'Arctared' Red Fescue also exhibited a fair performance.

Adak Advanced Evaluation Plot 1, Beach Sand Site

	#1 of 6 Blocks Planted 5/26/88	9/12/88		9/12/89		7/16/90		9/15/90		
		vigor	% stand							
1	'Nugget' Kentucky Bluegrass	6	10	3	30	3	80	3	80	1
2	'Merion' Kentucky Bluegrass	3	10	3	70	3	90	1	90	2
3	'Banff' Kentucky Bluegrass	3	30	5	40	7	60	7	60	3
4	'Park' Kentucky Bluegrass	7	5	5	20	5	70	5	70	4
5	'Sydsport' Kentucky Bluegrass	7	15	1	40	-	-	-	-	5
6	'Fylking' Kentucky Bluegrass	1	35	5	30	-	-	-	-	6
7	'Troy' Kentucky Bluegrass	7	50	-	-	-	-	-	-	7
8	Big Bluegrass 387931	7	10	-	-	-	-	-	-	8
9	'Sherman' Big Bluegrass	3	20	-	-	-	-	-	-	9
10	'Canbar' Canby Bluegrass	-	-	-	-	-	-	-	-	10
11	'Reubans' Canada Bluegrass	-	-	-	-	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	-	-	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	-	-	-	-	-	-	-	-	13
14	'Gruening' Alpine Bluegrass	-	-	3	60	3	60	3	70	14
15	'Sodar' Streambank wheatgrass	-	-	-	-	-	-	-	-	15
16	Bearded wheatgrass 371698	-	-	-	-	-	-	-	-	16
17	Bearded wheatgrass 236693	-	-	-	-	-	-	-	-	17
18	'Nordan' Crested wheatgrass	-	-	-	-	-	-	-	-	18
19	'Fairway' Crested wheatgrass	7	10	-	-	-	-	-	-	19
20	'Summit' Crested wheatgrass	5	20	-	-	-	-	-	-	20
21	Violet wheatgrass T12050	-	-	-	-	-	-	-	-	21
22	Boreal wheatgrass T12048	9	5	-	-	-	-	-	-	22
23	Yukon wheatgrass T12051	9	5	-	-	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	7	40	-	-	-	-	-	-	24
25	'Fults' Alkaligrass	5	60	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	5	10	-	-	-	-	-	-	26
27	'Engmo' timothy	7	15	9	20	9	10	9	10	27
28	'Climax' timothy	1	80	7	70	7	30	9	30	28
29	Beach wildrye 345978	1	15	5	40	3	20	3	30	29
30	Siberian wildrye 345600	3	60	-	-	-	-	-	-	30
31	'Caiggluk' Tilesy Sage	1	100	7	50	1	70	1	75	31
32	'Nortran' Tufted Hairgrass	3	30	3	70	-	-	-	-	32
33	'Norcoast' Bering hairgrass	1	90	1	100	1	80	1	90	33
34	Bluejoint	-	-	-	-	-	-	-	-	34
35	'Sourdough Bluejoint	-	-	-	-	-	-	-	-	35
36	Meadow foxtail	1	30	-	-	-	-	-	-	36
37	Geniculated foxtail 314565	1	100	-	-	-	-	-	-	37
38	Garrison Creeping foxtail	5	15	-	-	-	-	-	-	38
39	'Arctared' Creeping red fescue	3	75	5	50	3	100	3	100	39
40	'Boreal' Creeping red fescue	1	80	3	100	1	100	1	100	40
41	'Pennlawn' Creeping red fescue	3	95	3	75	3	90	1	100	41
42	Rough fescue 236849	1	100	1	100	1	100	1	100	42
43	American Sloughgrass T12053	-	-	-	-	-	-	-	-	43
44	'Durar' Hard fescue	-	-	-	-	-	-	-	-	44
45	'Highlight' Sheep fescue	5	60	5	25	-	-	-	-	45
46	'Covar' Sheep fescue	-	-	-	-	-	-	-	-	46
47	'Manchar' Smooth Brome	-	-	-	-	-	-	-	-	47
48	'Carlton' Smooth Brome	-	-	-	-	-	-	-	-	48
49	'Alyeska' Polar grass	1	40	-	-	-	-	-	-	49
50										50
51										51
52										52

Figure 3. Advanced Evaluation Plot.

Adak Advanced Evaluation Plot 2, Beach Sand Site

	#2 of 6 Blocks Planted 5/26/88	9/14/88		9/12/89		7/16/90		9/15/90		
		vigor	% stand							
1	'Nugget' Kentucky Bluegrass	7	15	5	50	1	90	1	90	1
2	'Merion' Kentucky Bluegrass	3	25	5	30	5	60	5	60	2
3	'Banff' Kentucky Bluegrass	5	30	7	30	7	30	9	30	3
4	'Park' Kentucky Bluegrass	9	25	2	60	3	60	3	60	4
5	'Sydsport' Kentucky Bluegrass	5	40	5	30	5	20	3	30	5
6	'Fylking' Kentucky Bluegrass	3	60	-	-	-	-	-	-	6
7	'Troy' Kentucky Bluegrass	3	40	-	-	-	-	-	-	7
8	Big Bluegrass 387931	7	30	5	50	3	60	5	70	8
9	'Sherman' Big Bluegrass	1	60	-	-	-	-	-	-	9
10	'Canbar' Canby Bluegrass	7	25	-	-	-	-	-	-	10
11	'Reubans' Canada Bluegrass	3	40	-	-	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	5	70	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	3	80	-	-	-	-	-	-	13
14	'Gruening' Alpine Bluegrass	3	75	3	60	5	30	5	30	14
15	'Sodar' Streambank wheatgrass	7	15	-	-	-	-	-	-	15
16	Bearded wheatgrass 371698	-	-	-	-	-	-	-	-	16
17	Bearded wheatgrass 236693	-	-	-	-	-	-	-	-	17
18	'Nordan' Crested wheatgrass	1	90	-	-	-	-	-	-	18
19	'Fairway' Crested wheatgrass	5	70	-	-	-	-	-	-	19
20	'Summit' Crested wheatgrass	-	-	-	-	-	-	-	-	20
21	Violet wheatgrass T12050	9	15	-	-	-	-	-	-	21
22	Boreal wheatgrass T12048	9	5	-	-	-	-	-	-	22
23	Yukon wheatgrass T12051	7	5	-	-	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	3	40	-	-	-	-	-	-	24
25	'Fults' Alkaligrass	3	70	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	3	25	-	-	-	-	-	-	26
27	'Engmo' timothy	5	80	-	-	-	-	-	-	27
28	'Climax' timothy	1	90	5	50	7	10	9	10	28
29	Beach wildrye 345978	3	10	7	40	-	-	-	-	29
30	Siberian wildrye 345600	5	60	-	-	-	-	-	-	30
31	'Caiggluk' Tilesy Sage	1	90	3	70	1	60	3	60	31
32	'Nortran' Tufted Hairgrass	5	40	3	80	-	-	-	-	32
33	'Norcoast' Bering hairgrass	1	90	1	100	1	100	1	100	33
34	Bluejoint	9	5	-	-	-	-	-	-	34
35	'Sourdough' Bluejoint	7	15	-	-	-	-	-	-	35
36	Meadow foxtail	3	20	-	-	-	-	-	-	36
37	Geniculated foxtail 314565	1	85	-	-	-	-	-	-	37
38	Garrison Creeping foxtail	5	15	-	-	-	-	-	-	38
39	'Arctared' Creeping red fescue	3	90	3	70	5	60	5	60	39
40	'Boreal' Creeping red fescue	3	90	3	70	5	60	5	60	40
41	'Pennlawn' Creeping red fescue	1	75	3	80	3	100	3	100	41
42	Rough fescue 236849	1	100	1	100	1	100	1	100	42
43	American Sloughgrass T12053	7	30	-	-	-	-	-	-	43
44	'Durar' Hard fescue	5	20	-	-	-	-	-	-	44
45	'Highlight' Sheep fescue	3	80	5	60	-	-	-	-	45
46	'Covar' Sheep fescue	7	25	-	-	-	-	-	-	46
47	'Manchar' Smooth Brome	3	15	-	-	-	-	-	-	47
48	'Carlton' Smooth Brome	7	10	-	-	-	-	-	-	48
49	'Alyeska' Polar grass	-	-	-	-	-	-	-	-	49
50										50
51										51
52										52

Figure 4. Advanced Evaluation Plot.

Adak Advanced Evaluation Plot 3, Beach Sand Site

	#3 of 6 Blocks Planted 5/26/88	9/13/88		9/12/89		7/16/90		9/15/90		
		vigor	% stand							
1	'Nugget' Kentucky Bluegrass	3	20	-	-	-	-	-	-	1
2	'Merion' Kentucky Bluegrass	3	50	-	-	-	-	-	-	2
3	'Banff' Kentucky Bluegrass	5	80	-	-	-	-	-	-	3
4	'Park' Kentucky Bluegrass	3	30	-	-	-	-	-	-	4
5	'Sydsport' Kentucky Bluegrass	3	40	-	-	-	-	-	-	5
6	'Fylking' Kentucky Bluegrass	3	60	1	60	-	-	-	-	6
7	'Troy' Kentucky Bluegrass	5	10	-	-	-	-	-	-	7
8	Big Bluegrass 387931	7	40	-	-	-	-	-	-	8
9	'Sherman' Big Bluegrass	1	25	-	-	-	-	-	-	9
10	'Canbar' Canby Bluegrass	5	10	-	-	-	-	-	-	10
11	'Reubans' Canada Bluegrass	7	15	-	-	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	9	15	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	-	-	-	-	-	-	-	-	13
14	'Gruening' Alpine Bluegrass	5	40	7	40	5	40	3	90	14
15	'Sodar' Streambank wheatgrass	7	30	-	-	-	-	-	-	15
16	Bearded wheatgrass 371698	-	-	-	-	-	-	-	-	16
17	Bearded wheatgrass 236693	-	-	-	-	-	-	-	-	17
18	'Nordan' Crested wheatgrass	5	25	-	-	-	-	-	-	18
19	'Fairway' Crested wheatgrass	7	30	-	-	-	-	-	-	19
20	'Summit' Crested wheatgrass	5	20	-	-	-	-	-	-	20
21	Violet wheatgrass T12050	9	10	-	-	-	-	-	-	21
22	Boreal wheatgrass T12048	-	-	-	-	-	-	-	-	22
23	Yukon wheatgrass T12051	7	5	-	-	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	7	45	-	-	-	-	-	-	24
25	'Fulst' Alkaligrass	1	85	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	5	40	-	-	-	-	-	-	26
27	'Engmo' timothy	7	80	-	-	-	-	-	-	27
28	'Climax' timothy	1	90	7	90	7	60	9	15	28
29	Beach wildrye 345978	7	15	3	30	3	10	3	20	29
30	Siberian wildrye 345600	3	20	-	-	-	-	-	-	30
31	'Caiggluk' Tilesy Sage	1	100	7	80	3	40	3	40	31
32	'Nortran' Tufted Hairgrass	5	40	5	60	-	-	-	-	32
33	'Norcoast' Bering hairgrass	1	70	1	100	5	30	3	60	33
34	Bluejoint	5	10	-	-	-	-	-	-	34
35	'Sourdough Bluejoint	3	30	-	-	-	-	-	-	35
36	Meadow foxtail	3	60	-	-	-	-	-	-	36
37	Geniculated foxtail 314565	3	75	1	60	5	20	5	20	37
38	Garrison Creeping foxtail	3	60	-	-	-	-	-	-	38
39	'Arctared' Creeping red fescue	5	40	5	70	3	80	3	80	39
40	'Boreal' Creeping red fescue	1	90	1	100	1	100	1	100	40
41	'Pennlawn' Creeping red fescue	3	75	3	95	2	100	2	100	41
42	Rough fescue 236849	1	85	1	100	3	100	2	100	42
43	American Sloughgrass T12053	3	60	-	-	-	-	-	-	43
44	'Durar' Hard fescue	7	15	-	-	-	-	-	-	44
45	'Highlight' Sheep fescue	5	40	5	50	-	-	-	-	45
46	'Covar' Sheep fescue	3	10	-	-	-	-	-	-	46
47	'Manchar' Smooth Brome	5	30	-	-	-	-	-	-	47
48	'Carlton' Smooth Brome	3	40	-	-	-	-	-	-	48
49	'Alyeska' Polar grass	-	-	-	-	-	-	-	-	49
50										50
51										51
52										52

Figure 5. Advanced Evaluation Plot.

Adak Advanced Evaluation Plot 4, Beach Sand Site

	#4 of 6 Blocks Planted 5/26/88	9/13/88		9/12/89		7/16/90		9/15/90		
		vigor	% stand							
1	'Nugget' Kentucky Bluegrass	3	40	5	40	3	50	3	50	1
2	'Merion' Kentucky Bluegrass	1	60	3	60	1	20	1	20	2
3	'Banff' Kentucky Bluegrass	3	65	-	-	-	-	-	-	3
4	'Park' Kentucky Bluegrass	5	60	-	-	-	-	-	-	4
5	'Sydsport' Kentucky Bluegrass	7	25	-	-	-	-	-	-	5
6	'Fylking' Kentucky Bluegrass	1	80	-	-	-	-	-	-	6
7	'Troy' Kentucky Bluegrass	5	30	-	-	-	-	-	-	7
8	Big Bluegrass 387931	9	15	-	-	-	-	-	-	8
9	'Sherman' Big Bluegrass	3	80	-	-	-	-	-	-	9
10	'Canbar' Canby Bluegrass	3	65	-	-	-	-	-	-	10
11	'Reubans' Canada Bluegrass	7	15	-	-	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	9	20	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	9	15	-	-	-	-	-	-	13
14	'Gruening' Alpine Bluegrass	8	5	-	-	-	-	-	-	14
15	'Sodar' Streambank wheatgrass	5	20	-	-	-	-	-	-	15
16	Bearded wheatgrass 371698	-	-	-	-	-	-	-	-	16
17	Bearded wheatgrass 236693	-	-	-	-	-	-	-	-	17
18	'Nordan' Crested wheatgrass	3	30	-	-	-	-	-	-	18
19	'Fairway' Crested wheatgrass	1	60	-	-	-	-	-	-	19
20	'Summit' Crested wheatgrass	5	50	-	-	-	-	-	-	20
21	Violet wheatgrass T12050	9	5	-	-	-	-	-	-	21
22	Boreal wheatgrass T12048	7	15	-	-	-	-	-	-	22
23	Yukon wheatgrass T12051	9	5	-	-	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	7	40	-	-	-	-	-	-	24
25	'Fulst' Alkaligrass	3	60	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	3	45	-	-	-	-	-	-	26
27	'Engmo' timothy	5	80	-	-	-	-	-	-	27
28	'Climax' timothy	1	95	9	20	9	30	9	50	28
29	Beach wildrye 345978	7	5	5	20	-	-	-	-	29
30	Siberian wildrye 345600	5	70	-	-	-	-	-	-	30
31	'Caiggluk' Tilesy Sage	1	90	1	80	3	60	3	100	31
32	'Nortran' Tufted Hairgrass	9	15	7	80	-	-	-	-	32
33	'Norcoast' Bering hairgrass	1	75	1	100	3	60	1	70	33
34	Bluejoint	9	5	-	-	-	-	-	-	34
35	'Sourdough' Bluejoint	9	10	-	-	-	-	-	-	35
36	Meadow foxtail	3	80	-	-	-	-	-	-	36
37	Geniculated foxtail 314565	1	100	-	-	-	-	-	-	37
38	Garrison Creeping foxtail	3	90	-	-	-	-	-	-	38
39	'Arctared' Creeping red fescue	3	65	5	60	2	90	3	90	39
40	'Boreal' Creeping red fescue	1	60	1	100	1	90	1	90	40
41	'Pennlawn' Creeping red fescue	1	75	3	100	3	60	3	60	41
42	Rough fescue 236849	1	70	1	100	1	100	1	100	42
43	American Sloughgrass T12053	7	25	-	-	-	-	-	-	43
44	'Durar' Hard fescue	5	15	-	-	-	-	-	-	44
45	'Highlight' Sheep fescue	3	30	1	80	-	-	-	-	45
46	'Covar' Sheep fescue	1	10	-	-	-	-	-	-	46
47	'Manchar' Smooth Brome	3	60	-	-	-	-	-	-	47
48	'Carlton' Smooth Brome	5	50	-	-	-	-	-	-	48
49	'Alyeska' Polar grass	3	25	-	-	-	-	-	-	49
50										50
51										51
52										52

Figure 6. Advanced Evaluation Plot.

Adak Advanced Evaluation Plot 5, Beach Sand Site

	#5 of 6 Blocks Planted 5/26/88	9/13/88		9/12/89		7/16/90		9/15/90		
		vigor	% stand							
1	'Nugget' Kentucky Bluegrass	7	10	1	80	3	50	5	20	1
2	'Merion' Kentucky Bluegrass	5	50	3	40	1	20	1	90	2
3	'Banff' Kentucky Bluegrass	-	-	-	-	-	-	-	-	3
4	'Park' Kentucky Bluegrass	5	10	-	-	-	-	-	-	4
5	'Sydsport' Kentucky Bluegrass	-	-	-	-	-	-	-	-	5
6	'Fylking' Kentucky Bluegrass	7	5	-	-	-	-	-	-	6
7	'Troy' Kentucky Bluegrass	5	30	-	-	-	-	-	-	7
8	Big Bluegrass 387931	3	15	1	70	3	10	-	-	8
9	'Sherman' Big Bluegrass	1	20	-	-	-	-	-	-	9
10	'Canbar' Canby Bluegrass	3	90	-	-	-	-	-	-	10
11	'Reubans' Canada Bluegrass	3	80	-	-	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	3	10	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	3	25	-	-	-	-	-	-	13
14	'Gruening' Alpine Bluegrass	3	70	1	100	3	70	3	90	14
15	'Sodar' Streambank wheatgrass	3	80	-	-	-	-	-	-	15
16	Bearded wheatgrass 371698	-	-	-	-	-	-	-	-	16
17	Bearded wheatgrass 236693	-	-	-	-	-	-	-	-	17
18	'Nordan' Crested wheatgrass	1	80	-	-	-	-	-	-	18
19	'Fairway' Crested wheatgrass	5	60	-	-	-	-	-	-	19
20	'Summit' Crested wheatgrass	3	80	-	-	-	-	-	-	20
21	Violet wheatgrass T12050	7	40	-	-	-	-	-	-	21
22	Boreal wheatgrass T12048	5	5	-	-	-	-	-	-	22
23	Yukon wheatgrass T12051	3	25	-	-	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	2	60	-	-	-	-	-	-	24
25	'Fulfs' Alkaligrass	5	50	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	3	80	-	-	-	-	-	-	26
27	'Engmo' timothy	5	90	-	-	-	-	-	-	27
28	'Climax' timothy	1	100	-	-	-	-	-	-	28
29	Beach wildrye 345978	1	80	3	50	3	80	3	80	29
30	Siberian wildrye 345600	3	60	-	-	-	-	-	-	30
31	'Caiggluk' Tilesy Sage	1	80	1	70	1	60	1	60	31
32	'Nortran' Tufted Hairgrass	1	40	5	15	5	40	5	60	32
33	'Norcoast' Bering hairgrass	1	80	1	100	1	100	1	100	33
34	Bluejoint	9	10	-	-	-	-	-	-	34
35	'Sourdough' Bluejoint	7	10	-	-	-	-	-	-	35
36	Meadow foxtail	5	80	-	-	-	-	-	-	36
37	Geniculated foxtail 314565	1	95	-	-	-	-	-	-	37
38	Garrison Creeping foxtail	7	30	-	-	-	-	-	-	38
39	'Arctared' Creeping red fescue	5	70	3	60	3	90	3	90	39
40	'Boreal' Creeping red fescue	3	85	1	100	1	90	3	90	40
41	'Pennlawn' Creeping red fescue	5	70	3	80	3	100	3	100	41
42	Rough fescue 236849	1	90	1	100	1	100	1	100	42
43	American Sloughgrass T12053	7	15	-	-	-	-	-	-	43
44	'Durar' Hard fescue	-	-	-	-	-	-	-	-	44
45	'Highlight' Sheep fescue	7	25	1	60	-	-	-	-	45
46	'Covar' Sheep fescue	9	19	-	-	-	-	-	-	46
47	'Manchar' Smooth Brome	3	30	-	-	-	-	-	-	47
48	'Carlton' Smooth Brome	3	60	-	-	-	-	-	-	48
49	'Alyeska' Polar grass	-	-	-	-	-	-	-	-	49
50										50
51										51
52										52

Figure 7. Advanced Evaluation Plot.

Adak Advanced Evaluation Plot 6

	#6 of 6 Blocks Planted 5/26/88	9/13/88		9/12/89		7/16/90		9/15/90		
		vigor	% stand							
1	'Nugget' Kentucky Bluegrass	5	40	3	100	1	80	1	80	1
2	'Merion' Kentucky Bluegrass	3	50	3	100	3	90	3	90	2
3	'Banff' Kentucky Bluegrass	7	15	-	-	-	-	-	-	3
4	'Park' Kentucky Bluegrass	3	25	-	-	-	-	-	-	4
5	'Sydsport' Kentucky Bluegrass	5	20	-	-	-	-	-	-	5
6	'Fylking' Kentucky Bluegrass	5	40	-	-	-	-	-	-	6
7	'Troy' Kentucky Bluegrass	1	70	-	-	-	-	-	-	7
8	Big Bluegrass 387931	5	60	1	80	1	90	1	90	8
9	'Sherman' Big Bluegrass	1	100	-	-	-	-	-	-	9
10	'Canbar' Canby Bluegrass	3	50	-	-	-	-	-	-	10
11	'Reubans' Canada Bluegrass	5	60	-	-	-	-	-	-	11
12	'Tundra' glaucus Bluegrass	9	40	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	7	60	-	-	-	-	-	-	13
14	'Gruening' Alpine Bluegrass	7	40	1	90	3	60	3	60	14
15	'Sodar' Streambank wheatgrass	3	80	-	-	-	-	-	-	15
16	Bearded wheatgrass 371698	9	5	-	-	-	-	-	-	16
17	Bearded wheatgrass 236693	7	5	-	-	-	-	-	-	17
18	'Nordan' Crested wheatgrass	3	50	-	-	-	-	-	-	18
19	'Fairway' Crested wheatgrass	5	70	-	-	-	-	-	-	19
20	'Summit' Crested wheatgrass	1	35	-	-	-	-	-	-	20
21	Violet wheatgrass T12050	5	20	-	-	-	-	-	-	21
22	Boreal wheatgrass T12048	7	30	-	-	-	-	-	-	22
23	Yukon wheatgrass T12051	5	40	-	-	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	3	20	-	-	-	-	-	-	24
25	'Fults' Alkaligrass	3	50	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	1	70	-	-	-	-	-	-	26
27	'Engmo' timothy	3	80	-	-	-	-	-	-	27
28	'Climax' timothy	1	100	5	100	3	100	7	30	28
29	Beach wildrye 345978	5	20	3	30	-	-	-	-	29
30	Siberian wildrye 345600	3	50	-	-	-	-	-	-	30
31	'Caiggluk' Tilesy Sage	1	75	1	100	-	-	-	-	31
32	'Nortran' Tufted Hairgrass	5	50	3	80	3	80	7	80	32
33	'Norcoast' Bering hairgrass	1	80	1	100	1	100	1	90	33
34	Bluejoint	-	-	-	-	-	-	-	-	34
35	'Sourdough Bluejoint	9	5	-	-	-	-	-	-	35
36	Meadow foxtail	3	20	-	-	-	-	-	-	36
37	Geniculated foxtail 314565	-	-	-	-	-	-	-	-	37
38	Garrison Creeping foxtail	3	10	-	-	-	-	-	-	38
39	'Arctared' Creeping red fescue	3	40	1	80	1	100	1	100	39
40	'Boreal' Creeping red fescue	3	90	1	100	1	100	1	100	40
41	'Pennlawn' Creeping red fescue	3	60	3	100	3	100	3	100	41
42	Rough fescue 236849	1	100	1	100	1	100	1	100	42
43	American Sloughgrass T12053	5	10	1	100	-	-	-	-	43
44	'Durar' Hard fescue	7	15	-	-	-	-	-	-	44
45	'Highlight' Sheep fescue	7	30	-	-	-	-	-	-	45
46	'Covar' Sheep fescue	5	20	-	-	-	-	-	-	46
47	'Manchar' Smooth Brome	7	30	-	-	-	-	-	-	47
48	'Carlton' Smooth Brome	5	50	-	-	-	-	-	-	48
49	'Alyeska' Polar grass	-	-	-	-	-	-	-	-	49
50										50
51										51
52										52

Figure 8. Advanced Evaluation Plot.

Adak Advanced Evaluation Plot 7, Landfill Site

	1 Block of Plantings Planted 5/25/88	9/13/88		9/12/89		7/15/90		9/14/90		
		vigor	% stand							
1	'Nugget' Kentucky Bluegrass	5	10	5	30	3	100	3	90	1
2	'Merion' Kentucky Bluegrass	3	80	3	70	1	100	1	90	2
3	'Banff' Kentucky Bluegrass	1	90	5	80	5	80	5	80	3
4	'Park' Kentucky Bluegrass	3	40	3	80	5	100	5	100	4
5	'Sydsport' Kentucky Bluegrass	5	20	7	60	5	80	5	80	5
6	'Fylking' Kentucky Bluegrass	1	90	1	100	3	100	3	100	6
7	'Troy' Kentucky Bluegrass	3	75	7	50	-	-	-	-	7
8	Big Bluegrass 387931	7	60	3	75	5	80	3	90	8
9	'Sherman' Big Bluegrass	1	50	-	-	-	-	-	-	9
10	'Canbar' Canby Bluegrass	3	85	-	-	-	-	-	-	10
11	'Reubans' Canada Bluegrass	5	75	5	80	7	60	-	-	11
12	'Tundra' glaucus Bluegrass	7	20	-	-	-	-	-	-	12
13	Glaucus Bluegrass T08867	5	90	3	80	3	80	1	90	13
14	'Gruening' Alpine Bluegrass	3	75	1	100	1	100	1	100	14
15	'Sodar' Streambank wheatgrass	5	80	-	-	-	-	-	-	15
16	Bearded wheatgrass 371698	-	-	-	-	-	-	-	-	16
17	Bearded wheatgrass 236693	-	-	-	-	-	-	-	-	17
18	'Nordan' Crested wheatgrass	3	50	-	-	-	-	-	-	18
19	'Fairway' Crested wheatgrass	3	80	-	-	-	-	-	-	19
20	'Summit' Crested wheatgrass	1	85	-	-	-	-	-	-	20
21	Violet wheatgrass T12050	7	10	-	-	-	-	-	-	21
22	Boreal wheatgrass T12048	9	10	-	-	-	-	-	-	22
23	Yukon wheatgrass T12051	7	20	-	-	-	-	-	-	23
24	'Critana' Thickspike wheatgrass	5	50	-	-	-	-	-	-	24
25	'Fulst' Alkaligrass	7	55	-	-	-	-	-	-	25
26	'Vantage' Reed Canarygrass	1	35	3	80	3	60	5	60	26
27	'Engmo' timothy	7	40	5	20	7	50	-	-	27
28	'Climax' timothy	3	60	3	30	5	80	7	80	28
29	Beach wildrye 345978	7	25	5	30	3	60	3	60	29
30	Siberian wildrye 345600	3	40	-	-	-	-	-	-	30
31	'Caiggluk' Tilesy Sage	1	80	-	-	-	-	-	-	31
32	'Nortran' Tufted Hairgrass	5	70	5	70	1	90	1	95	32
33	'Norcoast' Bering hairgrass	1	90	1	100	1	100	1	100	33
34	Bluejoint	7	10	-	-	-	-	-	-	34
35	'Sourdough Bluejoint	3	30	-	-	-	-	-	-	35
36	Meadow foxtail	1	100	3	80	7	50	9	50	36
37	Geniculated foxtail 314565	1	100	1	100	7	30	7	50	37
38	Garrison Creeping foxtail	3	90	-	-	-	-	-	-	38
39	'Arctared' Creeping red fescue	5	70	3	100	3	100	3	100	39
40	'Boreal' Creeping red fescue	1	95	1	100	1	100	1	100	40
41	'Pennlawn' Creeping red fescue	1	95	3	100	1	90	1	100	41
42	Rough fescue 236849	1	90	1	100	1	100	1	100	42
43	American Sloughgrass T12053	5	30	-	-	-	-	-	-	43
44	'Durar' Hard fescue	7	30	5	30	7	80	9	90	44
45	'Highlight' Sheep fescue	3	70	3	60	7	50	9	80	45
46	'Covar' Sheep fescue	9	25	-	-	-	-	-	-	46
47	'Manchar' Smooth Brome	7	25	-	-	-	-	-	-	47
48	'Carlton' Smooth Brome	9	10	-	-	-	-	-	-	48
49	'Alyeska' Polar grass	9	80	-	-	-	-	-	-	49
50										50
51										51
52										52

Figure 9. Advanced Evaluation Plot.

Seed Mix Evaluation Plot Results:

The six seed mix plots were also hand seeded, fertilized and raked in the same way as the advanced evaluation plots. However, instead of single accession plantings, only the seed mix was planted in these plots.

The mix consisted of 54% 'Norcoast' Bering Hairgrass, 36% 'Boreal' Red Fescue and 10% 'Caiggluk' Tilesy Sage. The mix was planted at a rate of 60 pounds per acre and fertilized with 20-20-10 at a rate of 500 pounds per acre.

The four abandoned quonset hut sites and the plot at the landfill produced excellent stands of vegetation. At the time of the final evaluation in September, 1990, 'Norcoast' Bering Hairgrass was the dominant variety and provided the highest cover. Overall, the seed mixes provided excellent results.

The plot established at a quarry site was destroyed in 1988.

Beach Wildrye Evaluation Results:

Three different Beach Wildrye studies were conducted.

One study used sprigs to help stabilize a 1.5 acre site. Techniques developed on Shemya were used for this planting. In an attempt to repeat the success attained on Shemya AFB, a sprigging program was attempted on Adak. An area noted for unwanted sand movement was selected and approximately 1.5 acres was sprigged using the same basic techniques developed on Shemya.

A second study involved fertilizing a .5 acre site consisting of a sparse, natural stand of Beach Wildrye. The intent was to determine the effectiveness of increasing stand density with fertilizer. The stand was fertilized at a rate of 500 pounds per acre.

The third Beach Wildrye study evaluated the effectiveness of directly seeding Beach Wildrye. Two sites were selected; one site contained beach sand, the other site contained a silty sand substrate typical of the landfill. Both plots were hand seeded with an accession of Beach Wildrye, PI 345978, which is being produced at the Alaska Plant Materials Center.

The sprigging project proved to be as successful as the previous projects on Shemya. The only failure occurred when a portion of the plot was planted with sprigs collected from an area that was not near the coast. Overall, the sprigging effort has been very successful both on active dune areas and sites removed from the dune.

Fertilizer as a management tool to increase the density of a natural stand proved to be a cost-effective practice. Density within the stand of Beach Wildrye increased by 80%. Management plans for foredune areas must include an annual maintenance fertilizer program which will help maintain healthy, vigorous stands of Beach Wildrye. Vigorous stands will insure that the maximum amount of blowing sand will be trapped by the revegetation.

Direct seeding of Beach Wildrye was very ineffective on the unstable beach sand. However, seeding was successful on the upland site. Sprigging appears to be the only viable method of establishing Beach Wildrye on areas of sand accumulation. Seedlings have germinated and are surviving on the dune site, but their vigor remains poor and growth is very limited. The species appears to rely on vegetative spread in active dune areas. This may explain why seedlings of Beach Wildrye have never been observed during any Alaska Plant Materials Center study of Beach Wildrye communities on active dune areas. Seed of this accession consistently performs better on more inland areas.

Willow Plantings on Adak Results:

In May, 1988, 40 of each of the following species of willow were planted at Adak:

1. Salix alaxensis, Feltleaf Willow
2. Salix bebbiana, Bebb Willow
3. Salix brachycarpa, Barren Ground Willow
4. Salix lasiandra, Pacific Willow
5. Salix barclayii, Barclay Willow

All of the willows were rooted 1-0 cuttings. The planting site was an exposed upland area. By September, 1990, only Feltleaf Willow variety 'Rhode' had survived. While performance at this site was marginal, 'Rhode' may have potential for additional trials in housing areas or at sites sheltered by buildings.

Conclusions and Recommendations:

The results of this study have provided useful revegetation information for Navy lands on Adak. The recommendations developed from this study are intended for use at sites with similar conditions on the Naval base or other parts of the island.

Seed Mixes:

Seed mixes will vary with intended use and elevation. Data collected from this study suggest that seed mixes developed for use on sites at Adak contain some or all of the following varieties.

Low Maintenance Areas (less than 150' elevation):

'Boreal' Red Fescue	<u>Festuca rubra</u>
'Norcoast' Bering Hairgrass	<u>Deschampsia beringensis</u>
'Arctared' Red Fescue	<u>Festuca rubra</u>
'Caiggluk' Tilesy Sage	<u>Artemisia tilesii</u>

Low Maintenance Areas (greater than 150' elevation):

'Gruening' Alpine Bluegrass	<u>Poa alpina</u>
'Norcoast' Bering Hairgrass	<u>Deschampsia beringensis</u>
'Nortran' Tufted Hairgrass	<u>Deschampsia caespitosa</u>
'Arctared' Red Fescue	<u>Festuca rubra</u>
'Boreal' Red Fescue	<u>Festuca rubra</u>
'Caiggluk' Tilesy Sage	<u>Artemisia tilesii</u>

High Maintenance Areas (less than 150' elevation):

'Nugget' Kentucky Bluegrass	<u>Poa pratensis</u>
'Merion' Kentucky Bluegrass	<u>Poa pratensis</u>
'Arctared' Red Fescue	<u>Festuca rubra</u>
'Boreal' Red Fescue	<u>Festuca rubra</u>
'Pennlawn' Red Fescue	<u>Festuca rubra</u>

General Seed Mixes:

Data collected from the evaluation plots indicate that the following seed mixes are suitable.

Low Maintenance Seed Mix:

'Norcoast' Bering Hairgrass	<u>Deschampsia beringensis</u>	60%
'Boreal' Red Fescue	<u>Festuca rubra</u>	20%
'Arctared' Red Fescue	<u>Festuca rubra</u>	15%
Annual Rye grass	<u>Lolium multiflorum</u>	5%

Lawns and Other Maintained Landscaped Areas:

'Nugget' Kentucky Bluegrass	<u>Poa pratensis</u>	30%
'Park' Kentucky Bluegrass	<u>Poa pratensis</u>	30%
'Boreal' Red Fescue	<u>Festuca rubra</u>	20%
Perennial Rye grass	<u>Lolium perenne</u>	20%

Beach Wildrye Plantings:

Transplanting Beach Wildrye sprigs has proven to be effective on Adak. However, using Beach Wildrye sprigs must be justified in either actual cost savings or environmental factors since the technique is more costly than standard seedings.

Willow Plantings:

No definitive conclusions can be drawn from the willow evaluations conducted in this study. All varieties but 'Rhode' Feltleaf willow died which suggests that sites need to be carefully selected before any additional plantings are made. Suitable planting sites may be found near buildings and Naval housing.

Further Information:

Additional information on revegetation on Adak can be obtained from the Adak Natural Resource Management Plan. Most of the revegetation information contained in the Management Plan was developed from the study outlined in this report.