FINAL REPORT
MILE POST 22 FLOODPLAIN VEGETATION STUDY
1995 - 2000

PREPARED FOR
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Introductory Note

Traditionally, the Alaska Plant Materials Center (PMC) does not become involved in transect oriented studies. However, this study as initiated by Alyeska Pipeline Service Company, incorporated the three most important practices associated with revegetation: seeding, fertilization and scarification. Both "with" and "without" application of the processes were evaluated against each other making this study quite important for future development in the region.

Background

The revegetation study was located on recently deposited gravel on the north side of Spur Dike 3 on the Sagavanirktok River near TAPS MP 22. This specific study was a stipulation in the permit required by Alyeska Pipeline Service Company to construct an overflow channel adjacent to Spur Dike 3.

The Alaska Department of Fish and Game, Title 16 Fish Habitat Permit for MP (TAPS Mile Post) 22 stated:

> Alyeska shall initiate a program to evaluate the riparian habitat developing on the north side of the spur dike in this reach of the Sagavanirktok River. The program shall include photo documentation and evaluation of habitat value to wildlife.

Additionally, the U.S. Army Corps of Engineers, Permit Modification for the MP 22 overflow/escape channel, stated the following:

> ...to mitigate project impacts, the permittee's agent and operator, Alyeska Pipeline Service Company (Alyeska), has proposed a study of plant recolonization in the vicinity of the project, which is included in the scope of work for this modification...

Purpose of the Study

The purpose of this study was to:

1. Determine the effectiveness of natural invasion (no treatment) of species native to an Arctic floodplain environment on the colonization of newly deposited gravel resulting from construction of spur dikes in the Sagavanirktok River.
2. Determine the effectiveness of soil amendments (fertilizer) in enhancing natural invasion of species native to an Arctic floodplain environment.
3. Determine the effectiveness of surface alteration (scarification) in enhancing natural invasion of species native to an Arctic floodplain environment.
4. Determine the feasibility and effectiveness of a light supplemental seeding of two (at least) naturally occuring floodplain species in enhancing establishment of species native to an Arctic floodplain environment.

Methods

1. **Plot Location and Layout**

The study was located on the recently deposited gravel on the north side of spur dike 3 on the Sagavanirktok River. The study plot was approximately one acre with twelve sub-units representing the various treatments. Within each sub-unit, twelve long-term photo plots were established.

The exact location of the study plot was determined on June 29, 1995 with the concurrence of the U.S. Fish and Wildlife Service. A single, one-acre plot was used with sub-units arranged as shown in Figure 1. The corners of the study plot were surveyed in and staked with appropriate markers (re bar) on June 29, 1995.

The number of photo plots within each sub-unit was determined after a description of the site was available and an assessment of the variation between sub-units was assessed (see, Figure 2).

Figure 1. Plot/Sub-Plot Design and Layout
As Built

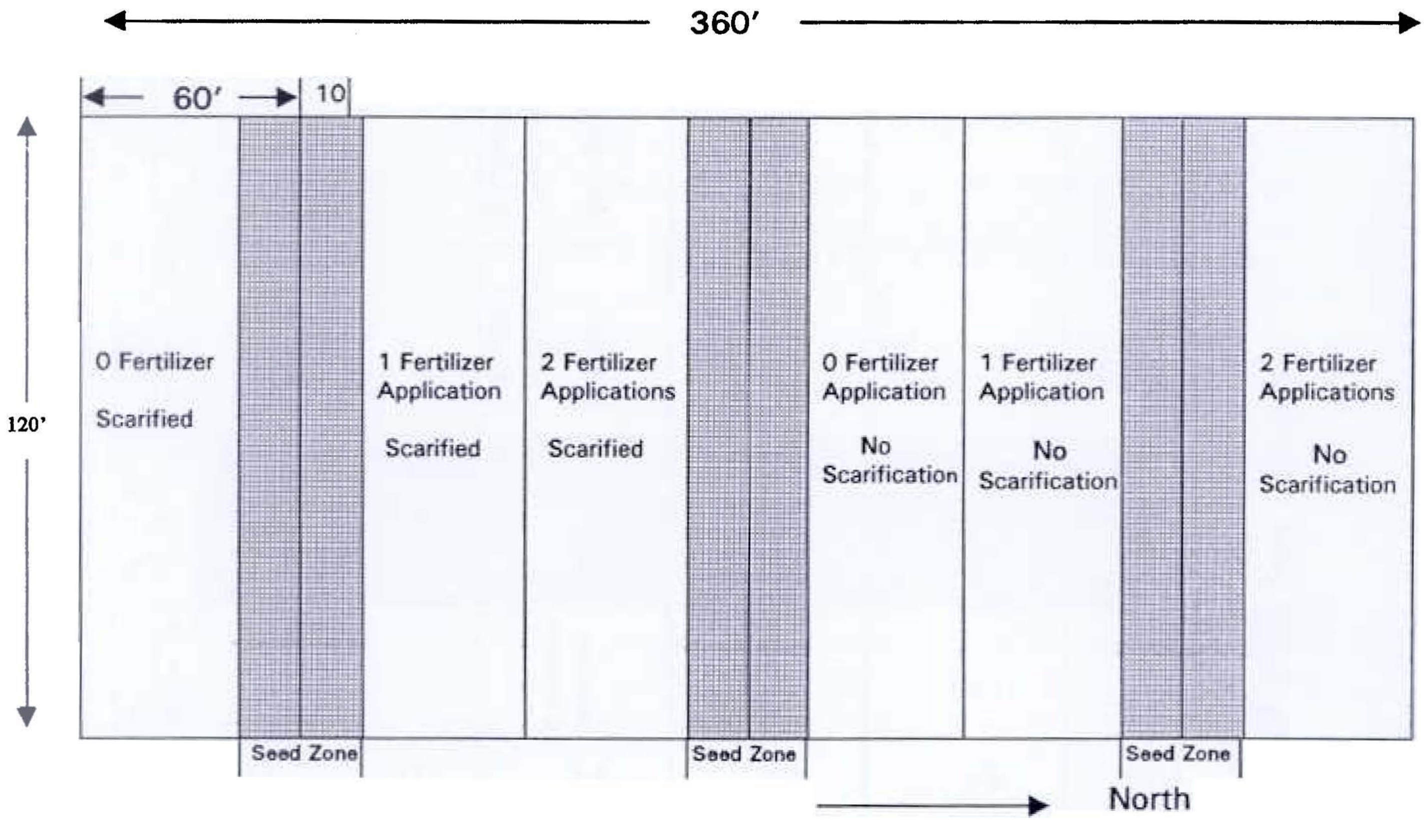
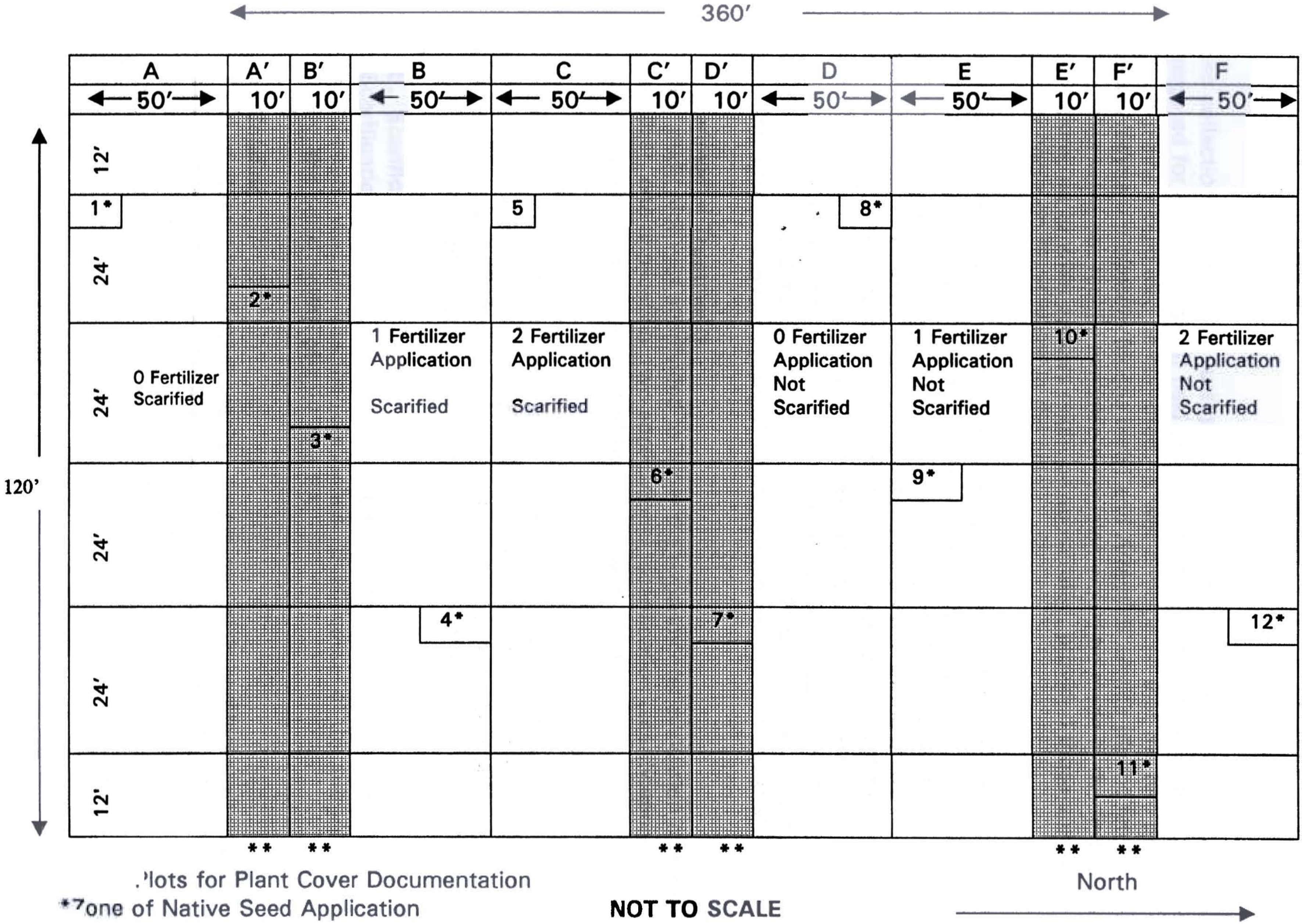


Figure 2. Plot/Sub-Plot Layout with Transects and Photo Plots
As Built



A seed collection trip occurred during August 15-19, 1995. A minimum of two species was targeted for collection and if field conditions permitted, additional species associated with flood plains would also be collected. It was anticipated that the two primary species would be *Hedysarum alpinum* (ripens early) and *Artemisia arctica* (ripens later). If seed for these species were not readily available a decision would be made in the field, based on site conditions, as to what species might be substituted, provided those species community occur on flood plains in the area.

The seed collected in 1995 was planted in July 2, 1996. If for some reason, no viable seed was collected in 1995 a second collection effort was planned for 1996, and the plantings would have been delayed a year. Had seed not been collected until 1996, the project would not have been extended and the seed portion of the study would have been eliminated. Fortunately, the collection effort of 1995 was accomplished as planned. That year (1995) proved to be an excellent year for seed production in the area. Not only was seed volume good, numerous species were available. The total amount of seed and species collected as well as the germination rates are listed in Table 1. Table 2 lists the amounts and species used in the supplemental seeding aspects of the study.

2. **Experimental Treatments**

The study plot was subdivided to allow the experimental evaluation of fertilizer (no fertilizer, one application, two applications), scarification (scarification vs. no scarification), use of native seed (versus natural invasion).

a. **Fertilizer**

Sub-units requiring fertilizer were treated with the 20-20-10 fertilizer at a rate of 500 pounds per acre on July 2, 1996. Those sub-units requiring two applications of fertilizer, were treated with 20-10-10 on July 2, 1996 and July 19, 1997. During each application, a rate of 500 pounds of fertilizer per acre was used.

b. **Scarification**

Scarification was accomplished with standard construction equipment. Depth of scarification was not less than six inches. Scarification of the sub-plots occurred during the construction of spur dike 3A.

c. **Seeding**

Seed of at least two native species, *Hedysarum alpinum/Mackenzii* and *Artemisia arctica*, were to be applied to scheduled areas within the sub-units. The number of species, amount of seed used, and the size of the seeded area was determined on the number of species and amount of seed collected.

Table 1. Total Seed Inventory for 1995 Collection.

Seed Test Numer	Species	Lot	Weight In Grams
193	*Hedysarum alpinum*	Heal PS3	78
194	*Hedysarum alpinum*	Heal Franklin	52.5
195	*Hedysarum alpinum*	Heal MP 73-74	5.8
196	*Hedysarum alpinum*	"under ripe"	2.6
197	*Hedysarum Mackenzii*	Hema PS3	34.8
198	*Astragalus alpinus*	Asal PMP 68-75	92.2
199	*Astragalus alpinus*	Asal 58-62+N of PS2	16.2
200	*Astragalus alpinus*	Asal NIP 96.4	13.3
201	*Oxytropis campestris*	Oxca PS3	201
	Astragalus nutzotinensis	Asnu	4.3
202	*Oxytropis campestris*	Oxca M 67.5	5.3
203	*Oxytropis campestris*	Oxca MP 96.4	29.1
204	*Oxytropis campestris*	Oxca MP 104 PS3	7.9
205	*Oxytropis campestris*	Oxca MP 73-75	11.5
206	*Oxytropis campestris*	Oxca 68.5 & 69.5	4
207	*Oxytropis campestris*	Oxca PS3M P104	0.5
208	*Oxytropis deflexa*	Oxde PS3	5.1
209	*Oxytropis deflexa*	Oxde MP 58-62	42
210	*Oxytropis deflexa*	Oxde MP 96.4	29.6
211	*Oxytropis deflexa*	Oxde MP 67.5	4.3
212	*Oxytropis visicida*	Oxvi PMP 68-75	3.3
213	*Oxytropis visicida*	Oxvi Franklin	475
214	*Artemisia arctica*	Arar MP 20.2	71.3
215	*Artemisia arctica*	Arar Franklin MP 20-21	237.5
216	*Artemisia borealis*	Arbo MP 20.2	1.9
217	*Artemisia borealis*	Arbo MP 20-21 Franklin	87.7
218	*Artemisia glomerata*	Argl MP 20	3.6
219	*Bromus Pumpellianus*	Brpu 95	0.7
220	*Calamagrosis purpurascens (lapponica)*	Capu 1-95	0.6
221	*Calamagrosis purpurascens (lapponica)*	Capu 2-95	0.8
222	*Agrostis borealis*	Agbo 2	6.3
225	*Elymus innovatus*	Elin Franklin 95	A=12.1
	(2 fraction A = lighter seed, B = better seed)		B = 22
252	Aster sibiricus	Assi PS3	0.4

Table 2. Species and amounts used for seed mix.

Species	Amount of Clean Seed Total of all Collections (grams)	Number of Collections	Average % Germination	Range of Germination *	Percent of Mix
Astragalus alpinus	121.7	3	45	38 – 59	8.8
Hedysarum alpinum	130.5	2	50	85 – 14	9
Hedysarum Mackenzii	34.8	1	66		2
Oxytropis campestris	259.3	7	30	54 – 15	17
Oxytropis deflexa	86.0	4	14	23 – 8	6
Oxytropis visicida	475.0	1	79		31
Artemisia arctica	308.8	2	92	98 – 90	21
Artemisia borealis	89.6	2	93		6
Total	1505.7	-	-	-	-

3. Data Collection

a. Photo Plots

Within each sub-unit, a single one-meter squared photo plot was permanently established and documented. Annual photos were taken and compared to evaluate percent cover. This process continued for five years starting in 1995. Three photo points were also established on spur dike 3 on June 29, 1995 to provide a distant view of the plot.

b. Transects

Five transects were established in a method to traverse each sub-unit along which species identifications were made and species variation documented. Records were maintained of all vegetation and cover encountered along the entire length of the 360-foot transects. Data collection continued for a total of five years starting in 1996.

Reporting of Results

The study was to culminate in a single report following the last growing season of the study. The report's intent was to document and evaluate the variation in plant density and plant species diversity on the sub-plots over the study period. The final report also include a discussion of the gravel deposition, if any, on the north side of the new spur dike 3A.

In addition to the twelve in-the-plot photo points, a photo point with a distant overview of the entire plot was established in 1996. These year after year photos can be observed in the Appendix.

Final Results and Conclusions

Qualification Statement

This study was conducted on a single site without replication on other gravel bars in the area. Therefore, all results and conclusions can be assumed to be very site specific. During the study, other unforeseen factors affecting the study became apparent. The first and most obvious of these factors was the gradual downhill grade leading to the river. Dynamics and yearly variations to physical properties of the site were expected. However, these were assumed to be uniform over the entire site. This appears to have been a false presumption. Transects 4 and 5 were affected more by erosion than the more elevated transects. This had an obvious effect on the data as the study progressed.

Another factor not initially taken into account, was the stilling affect on flowing water by the existing vegetation and even inanimate objects like the rebar plot corner markers. The stilling affect allowed for silt and fines to drop out of the water column during high water periods. This was very apparent down stream from each rebar as a "tail of silt". It is assumed that the same happened in the vegetated portions of the plot, with the down stream portion (north) of the plot benefiting the most. It can also be assumed that as the plot dropped in elevation toward the river (East), velocity of the flood waters would have been higher, and thus not allowing as much silt drop. So there was a degree of "built-in bias based on location and elevation" in the plot's layout. North would be favored over south and west favored over east.

Even the subtle differences in elevation may have contributed to skewed results; i.e., transect 3 was superior throughout the study: Was this the highest point on the gravel bar? Was it at the optimum elevation? The influence of these factors may have had an actual bearing on the results. Multiple plots, varied plot location and orientation would have clarified the issue. Unfortunately, this was a single plot study.

By far, the most significant oversight was the failure to adjust for age of the non-scarified portion. No matter by what measure of comparison made, the non-scarified portion of the plot is significantly older than the newly scarified section. Column "D", the untreated area, could represent a plant community that is perhaps 25 years old, albeit, a plant community on a very dynamic land form. The newly scarified portion is at most representative of a four-year old plant community. Expecting them to match in cover or diversity is at best questionable. However, with this said, the results are drawn to a conclusion within the defined purpose of this study.

Results

Study Purpose 1. *Determine the effectiveness of the natural invasion (no treatment) of species native to an Arctic floodplain environment on the colonization of newly deposited gravel resulting from the construction of spur dikes in the Sagavanirktok River.*

This is easy to quantify in this study as it simply reflects column "D" in the study. However, the gravel cannot be considered newly deposited as it is adjacent to a spur dike that is now 25 years old. Column "D" represents what was on the site in 1996 and what was on the site on August 21, 2000.

However, in reality Column "A" may be most representative of a newly deposited pile of gravel in a floodplain, as it received only the scarification treatment. If this is the case and can be classified to be non-treated, then the effectiveness can be suggested. But this will be addressed in purpose of the study, part 3.

Table 3. Number of Vegetation Hits Per Transect Segment
July 1996

	A	A'	B'	B	C	C'	D'	D	E	E'	F'	F
T-1	3	1	0	0	2	1	2	14	19	4	3	21
T-2	10	1	0	3	10	1	3	15	36	2	2	15
T-3	1	3	0	2	1	1	3	18	47	7	7	27
T-4	5	0	1	13	4	1	0	12	22	4	5	9
T-5	4	1	0	4	3	2	0	12	11	4	2	6
Total	23	6	1	22	20	6	8	71	135	21	19	78
Avg.	4.6	1.2	.2	4.4	4	1.2	1.6	14.2	27	4.2	3.8	15.6

Table 4. Number of Vegetation Hits Per Transect Segment
August 1996

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	4	1	0	1	1	1	2	16	48	8	4	33
T-2	11	2	2	2	19	0	2	25	52	7	1	23
T-3	1	5	3	1	4	0	4	35	57	13	8	39
T-4	8	0	2	14	7	2	1	14	27	6	7	19
T-5	3	3	2	7	3	0	1	9	20	4	5	5
Total	27	11	9	25	34	3	10	99	204	38	25	119
Avg.	5.4	2.2	1.8	5	6.8	0.6	2	19.8	40.8	7.6	5	23.8

North →

Table 5. Number of Vegetation Hits Per Transect Segment
August 1997

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	8	10	13	9	7	3	3	25	40	9	11	31
T-2	9	4	3	21	27	9	4	28	47	9	4	25
T-3	2	6	11	6	10	12	7	34	56	8	8	37
T-4	16	8	15	31	19	6	1	21	42	9	7	20
T-5	5	5	11	13	13	11	8	27	23	8	6	12
Total	40	33	53	80	76	41	23	135	208	43	36	125
Avg.	8	6.6	0.6	16	15.2	8.2	4.6	27	41.6	8.6	7.2	25

North →

Table 6. Number of Vegetation Hits Per Transect Segment August 1998

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	9	10	20	15	16	5	4	28	33	5	8	28
T-2	10	3	8	35	28	4	5	18	22	8	6	20
T-3	14	9	12	15	19	8	4	29	47	9	6	36
T-4	14	2	8	19	21	4	0	23	44	12	10	38
T-5	4	0	0	9	14	5	3	7	27	10	9	11
Total	51	24	48	93	98	26	16	105	173	44	39	133
Avg.	10.2	4.8	9.6	18.6	19.6	5.2	3.2	21	34.6	8.8	7.8	26.6

North →

Table 7. Number of Vegetation Hits Per Transect Segment August 1999

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	14	6	20	23	*	*	*	*	*	*	*	8
T-2	*	*	*	*	28	17	8	24	40	9	9	33
T-3	*	*	*	*	*	*	*	*	*	*	*	*
T-4	22	5	9	27	24	10	1	28	39	10	16	32
T-5	5	0	1	13	16	11	6	21	18	10	7	18
Total	41	11	30	63	68	38	15	73	97	29	32	83
Avg.	13.6	3.6	10	21	22.6	12.6	5	24.3	32.3	9.6	10.	27.6

* Field book with data lost.

North →

Table 8. Number of Vegetation Hits Per Transect Segment
August 2000

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	33	16	12	28	31	9	12	28	45	14	14	42
T-2	19	6	5	18	14	6	5	25	39	9	8	29
T-3	34	11	7	21	49	9	16	34	65	14	18	48
T-4	22	9	4	20	13	7	6	24	16	3	3	5
T-5	15	0	2	4	20	16	14	14	0	0	2	11
Total	123	42	30	91	127	47	50	125	165	40	45	135
Avg.	24.6	8.4	6	18.2	25.4	9.4	10	25	33	8	9	27

North →

In short, the effectiveness of doing nothing cannot be measured; only reported as is. How can the effectiveness of a natural process (Column "D") be rated? Column "D" is simply the goal or measure to achieve or match, keeping in mind its inherent natural dynamics.

Study Purposes

Study Purposes 2 & 3. *Determine the effectiveness of soil amendments (fertilizer) and surface alternatives (scarification) in enhancing natural invasion of species native to an Arctic floodplain environment.*

This aspect of the study produced some interesting observations. With regard to the number of vegetation hit measures, fertilizer seems to have no overall effect or perhaps even reduced the number of plants encountered on the transects in the non-scarified areas. When the study ended in 2000, the unfertilized treatment, Column "D", exhibited what could be considered a natural stand of vegetation for the area. A few factors must be noted in the values for columns "E" and "F". First, both treatments started the study in 1996 with more hits per segment than Column "D". On the July 1996 assessment, these plots did not in any way benefit from fertilizer as the fertilizer was applied the day after the measurements were taken. By August 1996, sufficient time for fertilizer affect to be noticed, Columns "E" and "F" both had an increased number of hits in their segments. However, so did "D", the non-fertilized portion.

At the end of the study, the unfertilized plot ("D" averaged 25 hits segment) in the non-scarified portion was nearly the same as the twice fertilized plot "F" (averaged 27 hits per segment) and only slightly less than the once fertilized plot "E" (averaged 33 hits per segment). With regard to the latter plot, keep in mind that in 1996, "E" had nearly twice the number of hits per segment than "D". Another factor influencing these numbers is the fact that Transects 4 and 5 in "E" and "F" were subjected to the erosive forces of the river and some plants in these plots were probably destroyed by the river.

In the scarified portion of the plot, fertilizer seems to have had a negligible affect. In 1996, the blocks "A", "B" and "C" had average hits per segment of 4.6, 4.4 and 4.0 respectively. At the end of the study, the same block "A" (no fertilizer), "B" (fertilized once) and "C" (fertilized twice) had averaged hits per segment of 24.6, 18.2 and 25.4 respectively; a significant numeric increase over 1996. However, the difference between the no fertilizer block ("A") and fertilized blocks ("B" and "C") was nearly identical. In fact, the non-fertilized scarified block "A" was almost identical to the non-fertilized non-scarified block "D", the possibly 25-year old vegetation stand. Based on these data the conclusion would be: Fertilizer had no impact over time on the number of hits per segment when compared to non-fertilized blocks.

Diversity Measures

Diversity values in this report are simply derived from the species composition present (Tables 9, 10 and 11) as noted by hits; i.e., identification of the species hit was done when plant presence (hits) was determined. As such, only in the most general terms does it meet the accepted standards of determining diversity. With that said, the data contained in Tables 9 through 11 gives the reader an idea of short-term invasion/colonization process on the scarified areas.

In the non-scarified portion of the plot, it gives the reader an idea what species could be encountered on a floodplain in the area as well as yearly variations along a given transect. Keep in mind transect tapes may not fall on the exact same line year after year, accounting for some of the variation.

Based on the facts that this was only a short term study and a single study site, along with the other previously mentioned short comings in this study, the data can only be used for information purposes. In addition, this information was not collected in 2000. The lack of real value of the data was realized in 1999. However, the loss of the 1999 data (field book) was not determined until the winter of 2000. Had this been known, the information would have been collected in 2000.

Plant Cover

Plant cover values were collected on an annual basis. This report only presents first and last evaluation year data. The study did show that a scarified non-fertilized site can after five growing seasons match a possibly 25-year old floodplain vegetative community. Interestingly enough, scarified sites that were fertilized ("B" and "C") performed the worst, while fertilized, non-scarified sites ("E" & "F") were identical to the non-fertilized, non-scarified site. But if an attempt is made to reduce the affect of erosion on the plot and identity data another picture emerges. If the two most highly eroded and impacted transects (T-4 and T-5) are removed from the data field, then the results are quite different.

Table 9. Species Composition Percent by Transect Segment and Treatment
7/1/96

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	66.6 EPLA	100.0 ARAR	0	0	50.0 EPLA	100.0 ARAR	50.0 ARBO	42.8 ARAR	73.6 EPLA	50.0 EPLA	33.3 EPLA	66.6 EPLA
	33.3 GRAM				50.0 ARAR		50.0 OXCA	35.7 HEMA	15.7 ARAR	50.0 GRAM	33.3 ARAR	14.3 HEMA
								21.4 EPLA	10.5 GRAM		33.3 HEMA	9.5 ARAR
												9.5 GRAM
T-2	70.0 ARAR	100.0 ARAR	0	66.6 ARAR	50.0 EPLA	100.0 EPLA	66.6 ARAR	53.2 EPLA	44.4 ARAR	50.0 EPLA	50.0 ARAR	33.3 EPLA
	20.0 EPLA			33.3 HEMA	50.0 ARAR		33.3 Salix	40.0 ARAR	41.7 EPLA	50.0 ARAR	50.0 ARBO	33.3 ARAR
	10.0 ARNB							6.7 HEMA	5.5 ARBO			13.3 ARBO
									5.5 GRAM			6.87 HEMA
									2.8 HEMA			6.27 Salix
T-3	100.0 HEM	33.3 EPLA	0	50.0 ARAR	100.0 GRA	100.0 EPLA	66.6 ARAR	50.0 ARAR	53.2 ARAR	57.1 ARAR	42.9 GRAM	48.1 ARAR
		33.3 ARAR		50.0 HEMA			33.3 GRAM	44.4 EPLA	36.1 EPLA	28.6 GRAM	28.5 ARAR	44.4 EPLA
		33.3 Salix						5.6 GRAM	6.3 GRAM	14.3 HEMA	14.3 HEMA	3.7 ARBO
									2.2 ASSP		14.3 Salix	3.7 HEMA
									2.2 HEMA			
T-4	60.0 EPLA	0	100.0 EPLA	53.8 ARAR	50.0 ARAR	100.0 ARAR	0	50.0 ARAR	40.9 ARAR	50.0 ARAR	80.0 ARAR	55.5 ARAR
	40.0 ARAR			30.8 EPLA	50.0 GRAM			25.0 ARBO	22.7 ARBO	25.0 EPLA	20.0 GRAM	33.3 EPLA
				15.4 GRAM				25.0 EPLA	18.2 GRAM	25.0 GRAM		11.1 GRAM
									13.6 EPLA			
									4.5 ASSP			
T-5	50.0 GRAM	100.0 ARAR	0	50.0 ARAR	66.6 EPLA	100.0 ARAR	0	50.0 ARAR	54.5 ARAR	50.0 ARBO	50.0 ARBO	50.0 ARAR
	25.0 EPLA			25.0 EPLA	33.3 ARAR			25.0 HEMA	27.3 EPLA	25.0 ARAR	50.0 ARAR	16.6 ARBO
	25.0 ARAR			25.0 GRAM				25.0 EPLA	9.1 GRAM	25.0 GRAM		16.6 HEMA
									9.1 ARBO			16.6 EPLA
% Avg. Per Treat-ment	ARAR 43.5 EPLA 34.8 GRAM 13.0 HEMA 4.3 ARBO 4.3	ARAR 66.6 EPLA 33.3 SALIX 33.3	EPLA 100.0	ARAR 54.5 EPLA 22.7 GRAM 13.7 HEMA 9.0	ARAR 45.0 EPLA 40.0 GRAM 15.0	ARAR 66.6 EPLA 33.3	ARAR 50.0 ARBO 12.5 OXCA 12.5 SALIX 12.5 GRAM 12.5	ARAR 49.2 EPLA 32.4 GRAM 8.5 HEMA 5.6 ARBO 4.2	ARAR 43.7 EPLA 38.5 GRAM 8.9 ARBO 5.9 ASSP 1.5 HEMA 1.5	ARAR 33.3 GRAM 28.6 EPLA 23.8 ARBO 9.5 HEMA 4.7	ARAR 47.3 GRAM 21.0 EPLA 15.8 HEMA 5.3 SALIX 5.3 ARBO 5.3	EPLA 44.9 ARAR 35.9 HEMA 7.7 ARBO 5.1 GRAM 3.8 OXCA 1.3 SALIX 1.3

ARAR	Artemisia arctica (forb)	EPLA	Epilobium latifolium (forb)
ARBO	Artemisia borealis (forb)	GRAM	Graminoid (true grass)
ASNU	Astragalus nutzotinensis (legume)	HEMA	Hedysarum Mackenzii (legume)
ASSP	Astragalus species (legume)	OXCA	Oxytropis campestris (legume)
CRNA	Crepis nana (forb)	SALIX	Salix species (shrub)

Table 10. Species Composition Percent by Transect Segment and Treatment 8/18/97

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	50.0 EPLA	40.0 ARAR	53.8 ARBO	33.3 OXCA	42.8 GRAM	66.6 ARAR	100.0 ARAR	40.0 EPLA	57.5 ARAR	55.5 EPLA	54.5 EPLA	19.4 EPLA
	37.5 ARAR	30.0 ARBO	38.5 ARAR	22.2 EPLA	14.3 HEMA	33.3 OXCA		28.0 HEMA	32.5 EPLA	45.5 ARAR	45.5 ARAR	64.5 ARAR
	12.5 OXCA	20.0 CRNA	7.7 GRAM	22.2 ARBO	14.3 ARAR			24.0 ARAR	7.5 GRAM			9.7 HEMA
		10.0 ASNU		11.1 ARAR	14.3 ARBO			4.0 GRAM	2.5 HEMA			3.2 OXCA
				11.1 CRNA	14.3 OXCA			4.0 CRNA				3.2 GRAM
T-2	77.7 EPLA	75.0 ARAR	66.6 ARAR	38.1 EPLA	44.4 ARAR	66.6 ARAR	50.0 ARAR	55.2 ARAR	55.3 ARAR	66.6 ARAR	100.0 ARAR	56.0 ARAR
	11.1 ARAR	25.0 EPLA	33.3 EPLA	38.1 ARAR	37.0 EPLA	11.1 EPLA	25.0 EPLA	27.7 EPLA	27.6 EPLA	22.2 EPLA		28.0 EPLA
	11.1 HEMA			19.0 GRAM	7.4 HEMA	11,1 ARBO	25.0 OXCA	6.4 GRAM	6.4 GRAM	11.1 HEMA		4.0 HEMA
				4.8 HEMA	7.4 GRAM	11.1 SALIX		6.4 HEMA	4.3 HEMA			4.0 SALIX
					3.7 ARBO			4.3 OXCA	4.3 ARBO			4.0 GRAM
									2.1 OXCA			4.0 ARBO
T-3	50.0 GRAM	50.0 EPLA	63.6 ARAR	57.0 GRAM	44.4 ARAR	66.6 ARAR	50.0 ARAR	42.9 ARAR	60.7 ARAR	50.0 ARAR	62.5 ARAR	62.2 ARAR
	50.0 HEMA	33.3 ARAR	9.1 GRAM	28.5 EPLA	37.0 EPLA	11.1 EPLA	25.0 EPLA	42.9 EPLA	25.0 EPLA	25.0 GRAM	12.5 EPLA	21.6 EPLA
		16.6 ARBO	9.1 ARBO	9.6 ARAR	7.4 HEMA	11.1 ARBO	25.0 OXCA	7.0 HEMA	10.7 GRAM	12.5 HEMA	12.5 SALIX	16.2 GRAM
			9.1 CRNA	4.8 HEMA	7.4 GRAM	11.1 SALIX		3.6 GRAM	1.8 ARBO	12.5 EPLA	12.5 HEMA	
					3.7 ARBO			3.6 CRNA	1.8 HEMA			
T-4	50.0 EPLA	40.0 ARAR	46.6 ARAR	41.9 GRAM	36.8 EPLA	50.0 ARBO	100.0 ARBO	76.2 ARAR	69.0 ARAR	55.5 ARAR	100.0 ARBO	75.0 ARAR
	31.2 ARAR	20.0 ASNU	33.3 ARBO	38.7 ARAR	31.6 ARAR	30.0 EPLA		9.5 EPLA	19.9 EPLA	33.3 EPLA		25.0 EPLA
	12.5 GRAM	20.0 OXCA	13.3 EPLA	19.3 EPLA	26.3 GRAM	20.0 ARAR		9.5 GRAM	11.9 GRAM	11.1 GRAM		
	6.3 ARBO	20.0 EPLA	6.7 OXCA		5.3 ARBO			4.8 ARBO				
T-5	50.0 ARAR	40.0 ARAR	54.5 ARAR	53.8 GRAM	46.2 GRAM	90.9 ARBO	37.5 ARAR	44.4 GRAM	56.5 ARAR	75.0 ARAR	50.0 ARAR	66.6 ARAR
	25.0 GRAM	40.0 EPLA	18.2 EPLA	23.1 ARAR	30.8 ARAR	9.1 GRAM	50.0 GRAM	37.0 ARAR	30.4 GRAM	12.5 EPLA	16.6 ARBO	8.3 EPLA
	25.0 EPLA	20.0 GRAM	18.2 GRAM	23.1 EPLA	15.3 EPLA		12.5 CRNA	14.8 EPLA	8.7 EPLA	12.5 GRAM	16.6 EPLA	8.3 ARBO
			9.1 ARBO		7.7 ARBO			3.7 ARBO	4.3 HEMA		16.6 GRAM	8.3 SALIX
												8.3 GRAM
% Avg. Per Treatment	EPLA 50.0 ARAR 30.0 GRAM 10.0 HEMA 5.0 OXCA 2.5 ARBO 2.5	ARAR 33.3 ARBO 27.2 EPLA 27.2 CRNA 6.1 ASNU 3.1 GRAM 3.1	ARAR 52.8 ARBO 24.5 EPLA 11.3 GRAM 7.5 CRNA 1.9 OXCA 1.9	ARAR 32.5 GRAM 31.3 EPLA 26.3 OXCA 3.6 ARBO 2.5 HEMA 2.5 CRNA 1.3	ARAR 38.2 EPLA 26.3 GRAM 25.0 ARBO 5.3 HEMA 3.9 OXCA 1.3	ARAR 36.6 ARBO 34.1 EPLA 19.5 OXCA 4.9 SALIX 2.4 GRAM 2.4	ARAR 43.5 GRAM 30.4 EPLA 8.7 OXCA 8.7 ARBO 4.3 CRNA 4.3	ARAR 49.6 EPLA 26.7 GRAM 14.0 HEMA 6.7 CRNA 1.5 ARBO 1.5	ARAR 60.0 EPLA 24.1 GRAM 11.5 HEMA 2.4 ARBO 1.4 OXCA 0.5	ARAR 58.1 EPLA 27.9 GRAM 9.3 HEMA 4.7	ARAR 66.6 EPLA 22.2 HEMA 2.8 SALIX 2.8 GRAM 2.8 ARBO 2.8	ARAR 64.8 EPLA 25.6 HEMA 3.2 GRAM 2.4 SALIX 1.6 ARBO 1.6 OXCA 0.8

ARAR	Artemisia arctica (forb)	EPLA	Epilobium latifolium (forb)
ARBO	Artemisia borealis (forb)	GRAM	Graminoid (true grass)
ASNU	Astragalus nutzotinensis (legume)	HEMA	Hedysarum Mackenzii (legume)
ASSP	Astragalus species (legume)	OXCA	Oxytropis campestris (legume)
CRNA	Crepis nana (forb)	SALIX	Salix species (shrub)

Doing this reduces the number of transects to three and then places the study further in question. But then the scarified, non-fertilized block "A" has a cover value slightly less than "D", the non-scarified, non-fertilized block, but a significantly lower cover value than the non-scarified, fertilized blocks "E" and "F". Even with the elimination of transects 4 and 5, the values of the scarified, fertilized blocks "B" and "C" are less than block "A". In fact, the fertilized, scarified blocks ("B" and "C") show the lowest cover value of all the treatments in the study at the close of the study.

Based on these data, scarifying a site but not fertilizing that site will result in a cover value within 3% of a 25-year old floodplain community in five growing seasons. Also, the data suggest that by fertilizing a long established natural floodplain community will result in an increase of plant cover of 10% - 12%, with other factors such as elevation excluded and the previously mentioned variables excluded. In short, "scarification only" seems to be the best method of re-establishing an acceptable vegetation community on a floodplain.

Study Purpose 4. *Determine the feasibility and effectiveness of a light supplemental seeding of two (at least) naturally occurring floodplain species native to an Arctic floodplain environment.*

The most significant impact of any treatment used was the supplemental distribution of native seed. In the subplots ("A" - "F"), the alpha prime designated sub-units ("A'" - "F'") areas exhibited a higher numeric value for plant cover in 2000 for every treatment. Adjusting the number of plant hits for distance of segments (x' x 5), all categories exhibited a higher numeric value for the seeded subplots than each specific subplots non-prime treatment area.

Table 12. Percent Plant Cover
7/1/96

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	0.3	0.5	0	0	0.2	0.5	1.0	1.4	1.9	2	1.5	2.1
T-2	1.0	0.0	0	0.3	0.1	0.5	1.5	1.5	3.6	1.0	1.0	1.5
T-3	0.1	1.5	0	0.2	0.1	0.5	1.5	1.8	4.7	3.5	3.5	2.7
T-4	0.5	0	0.5	1.3	0.4	0.5	0	1.2	2.2	2.0	2.5	0.9
T-5	0.4	0.5	0	0.4	0.3	1.0	0	1.2	1.1	2.0	1.0	0.6
Avg. Per Seg-Ment	0.46%	0.6	0.1	0.44	0.22	0.6	0.8	1.42	2.7	2.1	1.9	1.56

North →

Table 13. Percent Plant Cover
August 21, 2000

	A	A′	B′	B	C	C′	D′	D	E	E′	F′	F
T-1	14.2	31	21	9.4	24.7	31	42.5	12.8	36.4	40	42	23.1
T-2	34.8	24.5	24	7.4	13.4	29	39	40.6	33	38.5	72	62.2
T-3	13.3	27	18.5	9.3	14.4	20.5	38	18.2	32.2	36	41	21.3
T-4	21.8	52	20.5	12.3	4.7	10	11	18.4	13.8	4.0	5.5	3.7
T-5	6.9	0	3.5	2.7	4.9	41.5	43	12.7	0	0	1.5	4.3
Avg. Per Seg-Ment	18.2	26.9	17.5	8.2	12.4	26.4	34.7	20.5	23	23.7	32.4	22.9

North →

Conclusions

The study, while somewhat flawed, does allow for conclusions. Keeping in mind the limited coverage and lack of sufficient replication inherent in the study, the following can be concluded:

1. Supplemental seeding increases plant cover and the number of individual plants encountered on the transects. The value of these data increases cannot be judged. Nor can the long-term effects of the increased populations on overall community health and vigor.
2. "Scarification only" has more positive impact on re-establishing a vegetation community in this situation than any other single or combined treatment when compared to an existing vegetation stand.
3. Fertilizer had no positive affect on the results.
4. This study was a very valuable exercise, unfortunately, it was just too small in scale. It is something that should be expanded in the future. To that end, a more sophisticated study could fully answer those questions remaining as well as possibly verifying the conclusions contained in this study. A more in-depth study could also quantify the basic question of habitat value. If a habitat value for the floodplain communities can be established, the direct habitat improvement values of constructing Spur Dikes can be quantified and documented. Improving habitat through terrain modification has been a proven method of aiding waterfowl and other species. Perhaps, in the end, Spur Dikes will serve a two-fold purpose: habitat improvement and protection of a man-made structure.

APPENDIX

OF

PHOTOGRAPHIC

PLOTS

Photo Plot Overview, 7/96—8/00

7-96

9-96

8-97

8-98

8-99

8-00

Photo Plot 1, 7/96—8/00

7-96

PP 9-96

PP 1 8-97

PP 1 8-98

8-99

PP 8-00

Photo Plot 2, 7/96—8/00

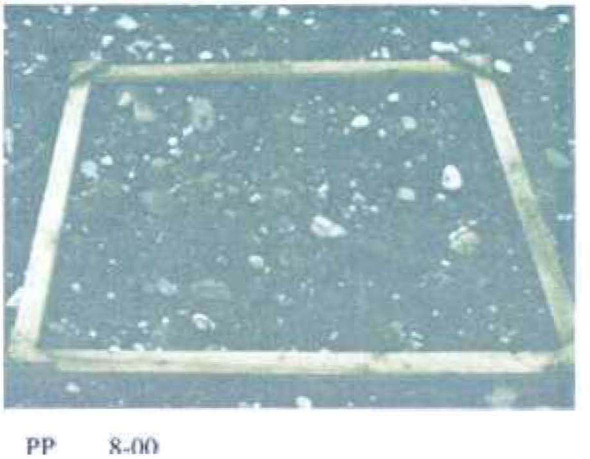
7-96

PP 9-96

8-97

PP 8-98

PP 8-99



PP 8-00

Photo Plot 3, 7/96—8/99

PP 3 7-96

PP 3 9-96

PP 3 8-97

PP 3 8-98

PP 3 8-99

Missing

Photo Plot 4, 7/96—8/00

7-96

PP 4   9-96

8-97

PP 4   8-98

8-99

PP4   8-00

Photo Plot 5, 7/96—8/99

7-96

PP 5 9-96

8-97

PP 5 8-98

8-99

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Photo Plot 6, 7/96—8/00

PP 6 7-96

PP 6 9-96

PP 6 8-97

PP 6 8-98

PP 6 8-99

PP6 9-00

Photo Plot 7, 7/96—8/00

PP 7 7-96

PP 7 9-96

PP 7 8-97

PP 7 8-98

PP 7 8-99

PP7 9-00

Photo Plot 8, 7/96—8/00

PP 8 7-96

PP 8 9-96

PP 8 8-97

PP 8 8-98

PP 8 8-99

PP8 9-00

Photo Plot 9, 7/96—8/00

PP 9 7-96

PP 9 9-96

PP 9 8-97

PP 9 8-98

PP 9 8-99

PP 9 8-00

Photo Plot 10, 7/96—8/00

PP 10 7-96

PP 10 9-96

PP 10 8-97

PP 10 8-98

PP 10 8-99

PP 10 9-00

Photo Plot 11, 7/96—8/99

PP 11 7-96

PP 11 9-96

PP 11 8-97

PP 11 8-98

PP 11 8-99

Missing

Photo Plot 12, 7/96—8/00

7-96

PP 12 9-96

8-97

PP 12 8-98

PP 12 8-99

PP12 8-00