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Unfinished Report
Arrowhead, Icy Bay

Introduction

Located in the southern portion of Wrangell-St. Elias National Park and Preserve, near Yakutat, AK is the highly glaciated Icy Bay area which has been rapidly deglaciating since the turn of the century.

Glaciers in the area are continuing to recede, even as other tidewater glaciers in the Gulf of Alaska, most notably the Hubbard Glacier, are in an advancing cycle. This glacial recession has created the present day configuration of Icy Bay, and has uncovered many square miles of barren land. It has been long recognized that the existence of barren lands created by glacial recession provide a unique opportunity to study vegetation, soil, and wildlife succession from its earliest stages (Cooper, 19??, etc.).

Located on the western shore of Icy Bay is a triangular peninsula of newly deglaciated land known as "the Arrowhead", because of its distinctive shape. The Arrowhead is surrounded by ocean on its northeastern and southern sides and by the receding face of the Guyot Glacier to the west. Thus, glacial recession at the Arrowhead also provides the opportunity to study succession of an area which is essentially an island, because it is not contiguous with any other land. Animal and plant populations at the Arrowhead must establish themselves from

Area Description

The Arrowhead is a triangular peninsula located on the western shore of Icy Bay, 75 miles northwest of Yakutat, AK (Fig ?). It is surrounded by ocean on its east, south and northern sides and bordered by the receding ice face of Guyot Glacier to the west. It is not contiguous with any other land. The Arrowhead is approximately 2 miles wide and 4 miles long and continues to become longer as the Guyot Glacier recedes to the west. It ranges from 0 feet to approximately 1000 feet in elevation, at its highest point. There is a large slab of remnant glacial ice which is melting into a lake at the approximate center of the Arrowhead.

The south facing perimeter of the Arrowhead is very steep and is largely unvegetated. The strata of the sedimentary material that make up the Arrowhead are obvious. The northeast facing perimeter is less steep (slopes?) and is characterized by large, often very steep erosion gullies that run from west to east. There are five of these canyons moving to the northwest from the easternmost tip of the Arrowhead. The uppermost portions of the Arrowhead are more gradually sloped.

The nearest vegetated areas are the Robinson Hills, approximately one mile across the Tsaa fjord to the south, the Guyot Hills, across Icy Bay two miles to the north and the Karr Hills, across Icy Bay three miles to the east. The Karr Hills and the Guyot Hills were uncovered by ice this century, but have been uncovered longer and are thus are more vegetated than the Arrowhead. The Robinson Hills have climax vegetation and thus have not been covered by ice in recent history.

Materials and Methods

Initially, the Arrowhead was reconnoitered to determine which vegetation types (Viereck, 1986) were present. Vegetation types were identified to level four according to Viereck's classification system. Three permanent transects were then established in each major vegetation type identified on the Arrowhead. Transects were 50 meters long and were permanently located at each end by three foot lengths of orange painted rebar. Because bedrock is usually very close to the surface, the rebar was often held in place by rock cairns. Ten 1/4 meter² low vegetation cover plots and ten 10 meter² tall shrub density and cover plots were surveyed along each 50 meter transect. The cover class scheme of Daubenmire, 1959 was used for % cover estimates. Cover classes are as follows:

% cover	cover class
1% - 5% =	1
5% - 25% =	2
25% - 50% =	3
50% - 75% =	4
75% - 95% =	5
95% - 100 =	6

To more accurately account for species with trace amounts of cover, a seventh cover class was included:

0% - 1% = trace or "+" cover class.

Starting from the "A" end of the transect, both the low vegetation cover and the tall shrub cover plots were located five meters apart starting at the 1 meter mark (1m, 6m, 11m, 16m, etc.). They are located on the right side of the transect, while facing the "B" transect end. The cover class of each herbaceous species and each shrub species under .31 meters (1 foot) was recorded in the low vegetation cover plot. In the shrub density plots, each individual shrub, its species and height (to the nearest foot) was recorded.

Then, in order to get cover data, cover class was estimated for each shrub species in the 10 square meter plot.

Terrain slope and aspect, transect azimuth, elevation, substrate moisture and Loran position were also recorded for each transect.

Appendix ? includes sample data sheets for both the low vegetation cover and the shrub density plots. Vascular plant nomenclature follows Hulten, 1968, except for willows which follow Viereck, 1974.

Photographs were taken from both ends of each transect and of soil pits when light conditions allowed. A plot board was used to indicate transect number in the photograph. Transect end and azimuth were also recorded. Aerial photographs were taken of transect sites and of landmarks on the Arrowhead.

At two transects per vegetation type, a soil pit was dug, and an array of soil characteristics were recorded. In addition, at each soil pit site, a soil sample was collected in a whirlpak bag for laboratory analysis of % organic matter, % nitrogen, % phosphorus, % potassium and particulate analysis. Appendix ? contains a sample soil data sheet and sheets that contain encoded information used to fill out the soil data sheets.

Results

From 8/23/1989 to 8/30/1989, a total of eight days were spent at the Arrowhead. The first few days were spent reconnoitering the Arrowhead and identifying the major vegetation types present. A total of fourteen permanent transects were located in the five vegetation types identified. Ease of access and relocatability were two major considerations in establishing representative permanent vegetation transects. Because of the lack of recent aerial photographs and of 1:63,360 maps, and because of ongoing erosion and the paucity of distinctive landmarks on the Arrowhead itself, permanent transect location sites that are easily relocatable and accessible were very limited. For each transect established, detailed directions for relocation were recorded and can be found in Appendix ?.

Species List

A total of 66 vascular plant species were sighted at the Arrowhead.

An additional 4 plant species were recorded by a WRST FirePro crew in August of 1987, for a total of 70 vascular plant species. Appendix ? lists all vascular plant species observed growing at the Arrowhead.

Species Abundance

In order to provide a relative measure of species abundance, each vascular plant species was given a rating according to its distribution throughout the area surveyed; common, scattered, uncommon and rare (five sightings or less). Table ? lists the relative abundance of all vascular plant species present at the Arrowhead. The abundance category assigned to each species can be expected to change as the Arrowhead continues to be colonized by new species and as species already present at the Arrowhead continue to disseminate themselves. The 11 plant species determined to be common in the area surveyed are typical pioneer species. These species represent the bulk of the vegetation biomass present at the Arrowhead. There were 24 species that were observed less than five times and often in only one location. Some of the species in the scattered, uncommon and rare abundance categories are more typical of mid-successional plant communities, eg. Picea sitchensis.

Table ?. Abundance of vascular plant species observed on the Arrowhead, August 23 through 30, 1989.

Common (11 species)	
Equisetum arvense	Equisetum variegatum subsp. variegatum
Alnus crispa subsp. sinuata	Sagina saginoides
Epilobium adenocaulon	Epilobium latifolium
Epilobium leptocarpum	Agrostis exerata
Agrostis scabra	Salix alaxensis
Salix sitchensis	
Scattered (14 species)	
Anaphalis margaritacea	Arabis hirsuta
Honkenya peploides subsp. major	Stellaria sp.
Carex kelloggii	Carex maritima
Carex Mertensii	Lupinus nootkatensis
Juncus arcticus subsp. sitchensis	Platanthera dilatata
Phleum commutatum var. americanum	Poa alpina
Trisetum spicatum subsp. spicatum	Populus balsamifera subsp.
Uncommon (17 species)	
Picea sitchensis	Aster subspicatus
Petasites hyperboreus	Prenanthes alata
Arabis lyrata subsp. kamchatica	Cerastium Beeringianum
Carex aurea	Juncus alpinus
Luzula parviflora	Calamagrostis canadensis
Elymus arenarius subsp. mollis	Poa glauca
Fragaria chiloensis	Sibbaldia procumbens
Salix commutata	Mimulus guttatus
Veronica serpyllifolia	
Rare* (24 species)	
Athyrium filix-femina	Botrychium lunaria
Heracleum lanatum	Ligusticum scoticum subsp. Hultenii
Achillea borealis	Senecio triangularis
Rorippa islandica	Eleocharis palustris
Empetrum nigrum	Luzula spicata
Epilobium angustifolium	Platanthera hyperborea
Spiranthes Romanzoffiana	Poa Merrilliana
Poa pratensis	Pyrola secunda
Actaea rubra subsp. arguta	Aruncus sylvester
Geum macrophyllum	Salix arctica
Leptarrhena pyrolifolia	Parnassia fimbriata
Parnassia palustris	Castilleja unalaschcensis

* 5 sightings or less

Vegetation Communities

The five vegetation types identified on the Arrowhead are listed in Table ? according to increasing distance from the face of the receding Guyot Glacier.

Table ?.

Community Type	Vegetation Type, Level Four (Viereck, 1986)
Barren community	Barren (< 10% dry seral forb herbaceous cover)
Moss community	Dry bryophyte
Equisetum community	Dry seral forb herbaceous
Alder community	Closed tall alder shrub
Beach community	Mesic mixed forb herbaceous

Low and Tall Vegetation Cover Plots

Tables ? and ? list by vegetation community, mean cover, total mean cover, frequency, importance value and importance value ranks for herbaceous vegetation and shrubs less than .31 meters tall (low vegetation). Table ? lists by vegetation community, mean cover, total mean cover, frequency, density, importance value and importance value ranks for all shrub species over .31 meters tall (tall vegetation). Table ? lists by vegetation type and by tall and low vegetation plots total cover by lifeform, ie. shrub, forb, graminoid, moss and lichen.

Barren Community

The barren community transects were located close (approx. 1/2 mile) to the face of the receding Guyot Glacier. It was estimated that the area had been free of ice five years or less at the time the transects were established. Only two species were present, Epilobium latifolium, (fireweed) and a species of moss, Rhacomitrium sp. Mean total low vegetation cover was 8.51%. Although the mean cover of Rhacomitrium was low (2.58%), its frequency was very high, (100.00%). The mean cover of E. latifolium was 5.93%, while its frequency is 70.00%. Mean barren ground cover was 94.38%.

Moss Community

The moss and barren ground communities at the Arrowhead are most similar to the dry bryophyte community described by Viereck, 1986.

Unlike the dry bryophyte vegetation type, which is described as having low cover, the moss community at the Arrowhead has high vegetative cover. According to Viereck, "dry bryophyte communities are an early successional stage,".

The mean total low vegetative cover of the moss community was 83.74%, while the mean cover of barren ground was 20.95%. The moss community had the lowest barren ground cover of any of the vegetation types surveyed. The mean cover and importance value of the dominant

vegetative species, Rhacomitrium sp. was 73.52%

Table K.

Species	BARREN (2)				MOSS (14)				EQUISETUM (16)				ALDER (16)			
	% x	%	IV	value	% x	%	IV	impt.	% x	%	IV	impt.	% x	%	IV	impt.
value	cover	freq.			cover	freq.		value	cover	freq.		value	cover	freq.		

BARREN	94.38	100.00			20.95	93.33			49.68	96.67			42.03	93.33		
LITTER	.88	50.00			1.80	87.67			3.93	96.67			19.77	100.00		
EPILAT	5.93	70.00	1	55.43	3.35	30.00	3	7.63	2.42	56.57	3	9.64				
MOSS 1	2.58	100.00	2	44.57	73.52	100.00	1	62.75	35.78	100.00	1	39.24	38.20	100.00	1	
35.75																
LICHEN					1.08	50.00	2	10.02	.02	3.33	16	.42	.40	13.33	9	
1.75																
SALALA					.35	20.00	4	3.96	.40	13.33	11	1.91	.17	16.67	8	
1.98																
AGRSCA					1.95	13.33	5	3.67	.60	6.67	13	1.26	.10	3.33	14	
.44																
CARMAR					2.60	10.00	6	3.43	.50	16.67	5	2.88				
FUNGUS					.17	16.67	7	3.23								
EQUARV					.20	6.67	8	1.37	.60	20.00	6	2.86	.60	6.67	12	
1.13																
FESSCA					.10	3.33	9	.69								
EQUVAR					.10	3.33	9	.69	19.05	93.33	2	25.70	7.25	6.67	3	
12.50																
AGREXE					.10	3.33	9	.69	.42	16.67	8	2.32	2.42	30.00	4	
4.92																
SALSIT					.10	3.33	9	.69	.72	13.33	10	2.15	.60	6.67	12	
1.13																
MOSS 2					.02	3.33	10	.64					1.42	26.67	6	
4.01																
CARAUR					.01	3.33	11	.63	1.30	13.33	7	2.59				

JUNARC					.90	30.00	4	4.29	.20	6.67	13	
.88												
SAGSAG					.33	16.67	9	2.25	.25	33.33	7	
3.89												
CARKEL					1.10	6.67	12	1.64				
EPILEP					.20	6.67	14	.95	1.40	33.33	5	
4.63												
PLADIL					.10	3.33	15	.55				
ALNCRI									23.87	66.67	2	
22.81												
EPIADE									.40	13.33	9	
1.75												
PARPAL									.30	10.00	10	
1.32												
PHLCOM									.22	10.00	11	
1.26												

total	8.51	170.00		83.74	266.65			66.19	416.67		77.80	446.67

Table ?. Beach Community

Species	% x cover	%rel. cover	% freq.	%rel. freq.	impt. value	IV rank
BARREN	30.48		100.00			
LITTER	17.08		100.00			
Shrubs						
ALNCRI	.52	.39	6.67	1.06	.73	17
SALSIT	.03	.02	3.33	.53	.28	20
subtotal	.55					
Forbs						
EQUARV	8.07	6.10	33.33	5.29	5.70	5
EQUVAR	4.57	3.46	26.67	4.23	3.85	8
ARALYR	.32	.24	13.33	2.12	1.18	13
HONPEP	.30	.23	10.00	1.59	.91	16
SAGSAG	.67	.53	33.33	5.29	2.91	9
STELL	5.10	3.86	40.00	6.35	5.11	6
LUPNOO	51.43	38.91	93.33	14.82	26.87	1
EPIADE	10.68	8.08	56.67	9.00	8.54	4
EPILAT	.83	.63	20.00	3.17	1.90	11
EPILEP	2.90	2.19	43.33	6.88	4.45	7
PLADIL	.50	.38	3.33	.53	.46	18
ACHBOR	.02	.02	3.33	.53	.28	20
ASTSUB	.10	.08	3.33	.53	.31	19
JUNARC	.40	.30	13.33	2.12	1.21	12
subtotal	85.89					
Graminoids						
CARMAR	.10	.08	3.33	.53	.31	19
CARKEL	2.08	1.57	3.33	.53	1.05	15
AGREXE	8.10	6.13	73.33	11.64	8.89	3
AGRSCA	1.20	.91	26.67	4.23	2.57	10
POAPRA	.30	.23	10.00	1.59	.91	16
ELYARE	.10	.08	3.33	.53	.31	19
PHLCOM	.02	.02	3.33	.53	.28	20
subtotal	11.90					
Moss/Lichens						
MOSS 1	33.53	25.37	86.67	13.76	19.57	2
MOSS 2	.22	.17	13.33	2.12	1.15	14
subtotal	33.75					
FUNGUS	.10	.08	3.33	.53	.31	19

TOTAL	132.19	629.96
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Table H. Shrubs > .31 m (1 ft.) tall.

Species	% x cover	% freq.	density shrb/ha	impt. value	IV rank
Moss Community					
SALSIT	1.90	50.00	599.9	43.41	1
SALALA	4.63	23.33	400.0	41.09	2
SALCOM	.40	13.33	133.3	10.33	3
ALNCRI	.20	6.67	66.7	5.17	4
total	7.13	93.33	1199.9		
Equisetum Community					
SALSIT	.32	13.33	233.3	52.92	1
SALALA	.30	10.00	233.3	47.08	2
total	.62	23.33	466.6		
Alder Community					
ALNCRI	65.00	100.00	17798.2	77.70	1
SALALA	4.12	47.67	633.3	11.14	2
SALSIT	1.52	27.67	533.3	6.29	3
POPTRI	2.68	10.00	133.3	3.19	4
SALCOM	.60	6.67	133.3	1.67	5
total	73.92	190.01	19231.4		

Table ?. Tall vegetation and low vegetation cover by life form.

	Barren	Moss	Equisetum	Alder	Beach
Tall vegetation					
Shrub(>.31m)		7.13	.62	73.92	
Low vegetation					
Barren	94.38	20.95	49.68	42.03	30.48
Litter	.88	1.80	3.93	19.77	17.08
Shrub(<.31m)		.45	1.12	24.64	.55
Forb	5.93	3.65	23.60	10.40	85.89
Graminoid		4.76	3.92	2.74	11.90
Moss	2.49	73.54	35.78	39.62	33.75
Lichen		1.08	.02	.40	
Fungus		.17			.10
Total	8.51	83.74	65.69	77.80	179.75

and 62.75, respectively. Epilobium latifolium had the next highest cover, 3.35% and a IV rank of 3. Graminoid species (Carex sp., Agrostis sp. and Festuca sp.) accounted for 4.76% of the vegetative cover. While lichens had low cover (1.08%), they had a high frequency (50.00%), giving them a importance value rank of 2 (IV 10.02). Although present, both species of Equisetum (E. variegatum and E. arvense) had low covers and low frequencies.

The moss community had a total cover of 7.13% and a density of 1199.9 tall shrubs per hectare. Salix sitchensis had the highest density (599.9/ha) and an importance value rank of 1 (IV 43.41). Salix alaxensis had the highest cover (4.63%) and an importance value rank of 2 (IV 41.09). Salix commutata and Alnus crispa were also present.

The moss community was the most widespread vegetative community at the Arrowhead.
Site chars

Equisetum Community

The Equisetum community at the Arrowhead was most similar to the dry seral forb herbaceous vegetation community. It is described as an "early successional community colonizing recently exposed surfaces" on sites with a coarse textured and excessively drained substrate (Viereck, 1986).

In the Equisetum community, the mean total low vegetative cover and

barren ground cover were 65.69% and 49.68%, respectively. Rhacomitrium sp. had the highest cover, 35.78% (IV 39.24), followed by Equisetum arvense, with a cover of 19.05% (IV 25.70). In the Equisetum community, Epilobium latifolium and Juncus arcticus both had low covers but relatively high frequencies, giving them importance value ranks of 3 (IV 9.64) and 4 (IV 4.29), respectively. Lichen species had a low cover and a low frequency giving them the lowest IV rank of 16 (IV 0.42).

Two shrub species, Salix sitchensis and S. alaxensis were surveyed in the Equisetum community. Together they had a total cover of 0.62%, and a density of 466.6 shrubs per hectare. No alder was sampled in the Equisetum community.

Equisetum vegetation communities were scattered and isolated throughout the Arrowhead and were usually limited in size (less than 1 hectare). Generally, their locations corresponded with areas with poor drainage and seepages, such as benches along slopes. They had less than half of the moss cover and more than twice as much bare ground cover than the moss community. A negligible component of the moss community, Equisetum variegatum was the secondmost dominant species in the Equisetum community. The total cover by forbs in the Equisetum community was 23.60% compared to a 3.65% coverage by forbs in the moss community.

Alder Community

Alder vegetation communities were found toward the distal end of the Arrowhead. Total mean cover of the low vegetation was 77.80%, while barren ground cover was 42.03%. Litter cover was relatively high, (19.77%). In descending order, the low vegetation species with the highest cover values in the alder community were Rhacomitrium sp., 38.20% cover (IV 35.75), Alnus crispa seedlings, 23.87% cover (IV 28.81), Equisetum variegatum, 7.25% cover (IV 12.50) and Agrostis exarata, 2.42% cover (IV 4.92). No Epilobium latifolium was surveyed in the alder community.

Total tall shrub cover in alder vegetation communities was 73.92%.

Total tall shrub density was 19,231.4 shrubs per hectare. The most dominant shrub surveyed was Alnus crispa, which had a cover of 65.00% and a density of 17,798.2 shrubs per acre, (IV 77.70). Salix alaxensis had a 4.12% cover, a density of 633.3 shrubs per hectare and an IV rank of 2 (IV 11.14). Salix sitchensis, Populus trichocarpa and Salix commutata had cover and importance values of 1.52% (IV 6.29), 2.68% (IV 3.19) and 0.60% (IV 1.67), respectively.

The alder community at the Arrowhead were at the borderline between the open tall alder shrub (<75% shrub cover, > 1.5 meters tall) and the closed tall alder shrub types (>75% shrub cover, > 1.5 meters tall) of Viereck (1986). Tall shrubs in the alder community were 73.92%, with shrubs averaging at least 1.5 meters tall. Viereck states that "Many alder stands on slopes below timberline will be

replaced by forests."

Beach Community

The beach community at the Arrowhead was most similar to the mesic mixed forb herbaceous type of Viereck, 1986. "These communities are dominated by herbs and have complete or nearly complete vegetative cover." "Mixed herb communities are found in small, local patches on deep, loamy, fairly well drained soils along streambanks, on stabilized dunes,...". At the Arrowhead, the beach community was found on essentially level ground (slopes ?% to ?%), exclusively along the narrow beach strand between the high tide line and where the terrain starts to rise in slope and elevation.

The beach community had a barren ground cover of 30.48% and a total low vegetation cover of 132.19%. Litter cover was 17.08%.

Twenty-five vegetation species were surveyed in the beach community.

Lupinus nootkatensis had the highest cover (51.43%), frequency (93.33%) and importance value (26.87). Other dominant species included Rachomitrium sp. with a cover of 33.53% (IV 19.57), Agrostis exarata with a cover of 8.10% (IV 8.89), Epilobium adenocaulon with a cover of 10.68% (IV 8.54) and Equisetum arvense with a cover of 8.07% (IV 5.70). The beach community had the highest cover of forbs (85.89%) and graminoids (11.90%) of any vegetation community surveyed. No lichens were sampled in the beach community. Although some shrub species seedlings were present (0.55%), no shrubs were surveyed in the tall vegetation plots.

In general, there are more plant species present in areas that are farther from the receding glacier face, ie closer to the tip of the Arrowhead.

Consider making some of the slides into prints to carry in the aircraft to aid in future transect relocation efforts. All slides are labeled and kept on file in the Resource Management office.

Appendix ?. Plant species list for the Arrowhead, Alaska. Compiled from the field inventory 8/89. Vascular plant nomenclature follows Hulten (1968) and Viereck (1972). Common names from Hulten and Anderson (1974).

taxon	common name
Division SPHENOPHYTA	
Equisetaceae (horsetail family)	
Equisetum arvense	common horsetail
Equisetum variegatum subsp. variegatum	variegated scouring-rush
Division PTEROPHYTA (ferns)	
Aspidiaceae (shield fern family)	
Dryopteris dilatata subsp. americana **	spinulose shield fern
Athyriaceae (lady fern family)	
Athyrium filix-femina subsp. cyclosorum	lady fern
Ophioglossaceae (adder's tougue family)	
Botrychium lunaria	moonwort
Division CONIFEROPHYTA (cone bearing plants)	
Pinaceae (pine family)	
Picea sitchensis	Sitka spruce
Division ANTHOPHYTA (flowering plants)	
Apiaceae (parsley family)	
Heracleum lanatum	cow parsnip
Ligusticum scoticum subsp. Hultenii	beach lovage
Asteraceae (sunflower family)	
Achillea borealis	common yarrow
Anaphalis margaritacea	pearly everlasting
Aster subspicatus	aster
Petasites hyperboreus	sweet coltsfoot
Prenanthes alata	rattlesnake root
Senecio triangularis	groundsel
Betulaceae (birch family)	
Alnus crispa subsp. sinuata	Sitka alder
Brassicaceae (mustard family)	
Arabis hirsuta subsp. Erschscholziana	hairy rock cress
Arabis lyrata subsp. kamchatica	lyrate rock cress
Rorippa islandica	marsh yellowcress

** additional plant species sighted by WRST FirePro in 1987.

taxon	common name
Caryophyllaceae (pink family) Cerastium Beeringianum var. Beeringianum Cerastium Beeringianum var. grandiflorum Honkenya peploides subsp. major Sagina saginoides Stellaria sp.	Beringian chickweed Beringian chickweed seabeach sandwort pearlwort starwort
Cyperaceae (sedge family) Carex atratiformis subsp. Raymondii ** Carex aurea Carex Kelloggii Carex macloviana ** Carex macrochaeta ** Carex maritima Carex Mertensii Eleocharis palustris	black sedge caviar sedge Kellogg sedge thick-head sedge long-awned sedge curved sedge Mertens sedge creeping spikerush
Empetraceae (crowberry family) Empetrum nigrum	crowberry
Fabaceae (pea family) Lupinus nootkatensis	nootkaten lupine
Juncaceae (rush family) Juncus alpinus Juncus arcticus subsp. sitchensis Luzula parviflora Luzula spicata	alpine rush arctic rush small-flowered wood rush spiked wood rush
Onagraceae (evening primrose family) Epilobium adenocaulon Epilobium angustifolium Epilobium latifolium Epilobium leptocarpum	northern willow-herb fireweed river beauty willow-herb
Orchidaceae (orchid family) Platanthera dilatata Platanthera hyperborea Spiranthes Romanzoffiana	white bog orchis northern bog orchis hooded ladies' tresses
Poaceae (grass family) Agrostis exerata Agrostis scabra Calamagrostis canadensis subsp. Langsdorffii Elymus arenarius subsp. mollis var. mollis Phleum commutatum var. americanum Poa alpina	spike redtop tickle grass bluejoint dune grass timothy grass alpine bluegrass

taxon	common name
Poaceae cont.	
<i>Poa glauca</i>	glaucous bluegrass
<i>Poa Merrilliana</i>	bluegrass
<i>Poa pratensis</i>	bluegrass
<i>Trisetum spicatum</i>	downy oat grass
Pyrolaceae (wintergreen family)	
<i>Pyrola secunda</i>	one-sided wintergreen
Rancunculaceae (crowfoot family)	
<i>Actaea rubra</i> subsp. <i>arguta</i>	red baneberry
Roseaceae (rose family)	
<i>Aruncus sylvester</i>	goatsbeard
<i>Fragaria chiloensis</i> subsp. <i>pacifica</i>	beach strawberry
<i>Geum macrophyllum</i> subsp. <i>macrophyllum</i>	large-leaf avens
<i>Sibbaldia procumbens</i>	sibbaldia
Salicaceae (willow family)	
<i>Populus balsamifera</i> subsp. <i>trichocarpa</i>	black cottonwood
<i>Salix alaxensis</i>	Alaska willow
<i>Salix arctica</i>	arctic willow
<i>Salix commutata</i>	undergreen willow
<i>Salix sitchensis</i>	Sitka willow
Saxifragaceae (saxifrage family)	
<i>Leptarrhena pyrolifolia</i>	leatherleaf saxifrage
<i>Parnassia fimbriata</i>	fringed grass-of-Parnassus
<i>Parnassia palustris</i>	northern grass-of-Parnassus
Scrophulariaceae (figwort family)	
<i>Castilleja unalaschcensis</i>	unalaska Indian paintbrush
<i>Mimulus guttatus</i>	yellow monkey-flower
<i>Veronica serpyllifolia</i> subsp. <i>humifusa</i>	speedwell

Appendix ?. Six letter acronyms of vascular plant species recorded on vegetation data sheets, Arrowhead, 1989.

taxon	6 letter acronym
Division SPHENOPHYTA	
Equisetaceae (horsetail family)	
Equisetum arvense	EQUARV
Equisetum variegatum subsp. variegatum	EQUVAR
Division PTEROPHYTA (ferns)	
Athyriaceae (lady fern family)	
Athyrium filix-femina subsp. cyclosorum	ATHFIL
Ophioglossaceae (adder's tongue family)	
Botrychium lunaria	BOTLUN
Division CONIFEROPHYTA (cone bearing plants)	
Pinaceae (pine family)	
Picea sitchensis	PICSIT
Division ANTHOPHYTA (flowering plants)	
Apiaceae (parsley family)	
Heracleum lanatum	HERLAN
Ligusticum scoticum subsp. Hultenii	LIGSCO
Asteraceae (sunflower family)	
Achillea borealis	ACHBOR
Anaphalis margaritacea	ANAMAR
Aster subspicatus	ASTSUB
Petasites hyperboreus	PETHYP
Prenanthes alata	PREALA
Senecio triangularis	SENTRI
Betulaceae (birch family)	
Alnus crispa subsp. sinuata	ALNCRI
Brassicaceae (mustard family)	
Arabis hirsuta subsp. Erschscholziana	ARAHIR
Arabis lyrata subsp. kamchatica	ARALYR
Rorippa islandica	RORISL
Caryophyllaceae (pink family)	
Cerastium Beeringianum var. Beeringianum	CERBEE
Cerastium Beeringianum var. grandiflorum	CERBEE
Honkenya peploides subsp. major	HONPEP
Sagina saginoides	SAGSAG

Stellaria sp.	STELL
taxon	6 letter acronym
Cyperaceae (sedge family)	
Carex aurea	CARAUR
Carex Kelloggii	CARKEL
Carex maritima	CARMAR
Carex Mertensii	CARMER
Eleocharis palustris	ELEPAL
Empetraceae (crowberry family)	
Empetrum nigrum	EMPNIG
Fabaceae (pea family)	
Lupinus nootkatensis	LUPNOO
Juncaceae (rush family)	
Juncus alpinus	JUNALP
Juncus arcticus subsp. sitchensis	JUNARC
Luzula parviflora	LUZPAR
Luzula spicata	LUZSPI
Onagraceae (evening primrose family)	
Epilobium adenocaulon	EPIADE
Epilobium angustifolium	EPIANG
Epilobium latifolium	EPILAT
Epilobium leptocarpum	EPILEP
Orchidaceae (orchid family)	
Platanthera dilatata	PLADIL
Platanthera hyperborea	PLAHYP
Spiranthes Romanzoffiana	SPIROM
Poaceae (grass family)	
Agrostis exarata	AGREXE
Agrostis scabra	AGRSCA
Calamagrostis canadensis subsp. Langsdorffii	CALCAN
Elymus arenarius subsp. mollis var. mollis	ELYARE
Phleum commutatum var. americanum	PHLCOM
Poa alpina	POAALP
Poa glauca	POAGLA
Poa Merrilliana	POAMER
Poa pratensis	POAPRA
Trisetum spicatum	TRISPI
Pyrolaceae (wintergreen family)	
Pyrola secunda	PYRSEC
Rancunculaceae (crowfoot family)	
Actaea rubra subsp. arguta	ACTRUB

taxon	6 letter acronym
Roseaceae (rose family)	
Aruncus sylvester	ARUSYL
Fragaria chiloensis subsp. pacifica	FRACHI
Geum macrophyllum subsp. macrophyllum	GEUMAC
Sibbaldia procumbens	SIBPRO
Salicaceae (willow family)	
Populus balsamifera subsp. trichocarpa	POPBAL
Salix alaxensis	SALALA
Salix arctica	SALARC
Salix commutata	SALCOM
Salix sitchensis	SALSIT
Saxifragaceae (saxifrage family)	
Leptarrhena pyrolifolia	LEPPYR
Parnassia fimbriata	PARFIM
Parnassia palustris	PARPAL
Scrophulariaceae (figwort family)	
Castilleja unalaschensis	CASUNA
Mimulus guttatus	MIMGUT
Veronica serpyllifolia subsp. humifusa	VERSER

Discussion

Revegetation in the vicinity of the receding glacial front
Difference between Alnus plots in terms of bedrock proximity
General successional pattern observed on the Arrowhead
The lake and the opportunity to study its succession
Soils and their succession
Relative abundance of species observed
LUPNOO up the erosion gullies/future stream courses
List of pertinent reports and papers on file to start out with
N-fixers; Alnus, lupine, no DRDR, no SHECAN
Problem of relocatability
Mapping problems
Proximity to other vegetated land.

Transect: _____ Location: _____ Veg. Type: _____

Observers: _____ Date: _____ Page ____ of ____

[illegible]

[illegible]

Appendix ?. Location descriptions of the 14 permanent vegetation transects established on the Arrowhead, 1989.

Transect 1 Moss Community

General location: From a rock cairn at the top of knoll 2, the second highest knoll in the southeastern region of the Arrowhead, travel at 290° to 1A. There is a 9 foot poplar tree (as of 1989), the largest one in the general area, approximately 15 feet to the south of 1A.

Community type: Dry bryophyte, 1989
Loran:
Elevation: approx 700 feet
Cairn to 1A: 290° approx. 120 feet
1A to 1B: 280°
1B to 1A: 100°
Terrain slope: 18%
Terrain aspect: 20°

Transect 2 Moss Community

General location: Transect 2 is located below knoll 1 and can be approached from transect 5. Endstake 2B is located in some willow bushes, while 2A is relatively out in the open.

Community type: Dry bryophyte, 1989
Loran: N 60 052 W 141 295
Elevation: 765 feet
5A to 2A: 358° 150 feet
2A to 2B: ? (roughly NE, verify this)
2B to 2A: ? (roughly SW, verify this)
Terrain slope: 0%
Terrain aspect: none

Transect 3 Moss Community

General location: Refer to the directions for transect 2.

Community type: Dry Bryophyte, 1989
Loran:
Elevation: 800 feet
2A to 3A: 275° 410 feet
3A to 3B: ?
3B to 3A: ?
Terrain slope:
Terrain aspect:

Transect 4 Equisetum Community

General location: Transect 4 is located near the top of the tallest knoll, knoll 1. Start pacing from the stack of three stones at the highest point of knoll 1 down to the first wide, flat terrace ledge in which the transect is located.

Community type: Dry seral forb herbaceous, 1989

Loran: N 60 052 W 141 292

Elevation: 825 feet

Knoll 1 to 4A 290° approx. 118 or 380 feet (please verify which)

5B to 4A: 135° 420 feet

4A to 4B: 150° (140°)

4B to 4A: 330° (320°)

Terrain slope: 30%

Terrain aspect: 230°

Transect 5 Equisetum Community

General location: Transect 5 is located on the southwest side of knoll 1, between the summit of the knoll and the fjord to the south of the Arrowhead. At the top of knoll 1 is a rock cairn from which transect 5 can be approached.

Community type: Dry seral forb herbaceous, 1989.

Loran: N 60 052 W 141 295

Elevation: approx. 765 feet

Knoll 1 to 5A: 310° approx. 835 feet

2A/B to 5A: 178° approx. 150 feet

4A to 5B: 315° approx. 420 feet

5A to 5B: 152°

5B to 5A: 332°

Terrain slope: 0%

Terrain aspect: none

Transect 6 Equisetum Community

General location: From the top of the knoll 2 travel at 260° approximately 200 feet vertical distance to 6A. The transect is located in the ledge of a terrace and has an approximate NW/SE orientation. The slope again increases below the ledge continuing on the same bearing down the hill.

Community type: Dry seral forb herbaceous, 1989.

Loran:

Elevation: approx 200 feet below the summit of Knoll 2

Terrain slope: approximately 25 degrees
Terrain aspect: 263°

Transect 7 Alder Community

General location: Transect 7 is located near the USGS benchmark Toyug which was established in the 1970's. Last updated in 1959, it is not represented on the 1:63,360 USGS Bering Glacier A-2 map because that point was still covered by glacial ice. Toyug is at the tip of the Arrowhead where the land has been deglaciated the longest period of time. It is up on top of the bluff, where the steep slope up from the ocean levels out considerably; on a cleared area where surface bedrock has prevented alder from filling in completely. There are some large peices of wood and other debris at the benchmark site which makes it highly visible from the air.

Community type: Closed tall alder shrub, 1989.

Loran: N 60 049 W 141 273

Elevation: 235 feet

Toyug to 7A: 328° approx. 135 feet

7A to 7B: 276°

7B to 7A: 96°

Terrain slope: 10 - 15%

Terrain aspect: 180°

Transect 8 Alder Community

Transect is located near sea level on the north side of the third canyon to the south of the canyon and creek created by the lake and remnant ice located on top of the Arrowhead. From the approximate high tide mark where the vegetation begins, walk up the creekbed to where there is a flat stone on north side of the creek with a cairn on top of it. While walking, you'll pass a stand of lupine on your left then on the right, then alder and driftwood, then a small rocky seep? on the right about 10 feet tall, then some more alder on the right and eventually the cairn 1 on the right. The walk is between 440 and 490 feet. From the cairn 1 on the creekbed, travel approximately 110 feet at a 18° bearing to cairn 2.

Community type: Closed tall alder shrub, 1989.

Loran:

Elevation: 50 feet

Cairn 2 to 8A: 325° approx 20 feet directly up the ridge

8A to 8B: 290°

8B to 8A: 110°

Terrain slope: 35%

Terrain aspect: 70°

Transect 9 Alder Community

General location: See the directions to transect 7 to locate the benchmark Toyug. Note: all plots done on the left side of the transect moving from stake 9A to 9B.

Community type: Closed tall alder shrub, 1989.

Loran: N 60 049 W 141 273

Elevation: 235 feet

Toyug to 9A: 35° approx. 90 feet

9A to 9B: 336°

9B to 9A: 156°

Terrain slope: 19%

Terrain aspect: 60°

Transect 10 Beach Community

General location: Transect 10 is located on the north side of the first large creek/canyon encountered traveling northwest from the farthest east point on the Arrowhead. There is a small creek just north of the transect. 10A is located approximately 5 to 10 feet west (away from the shore) of the vegetation edge. 10B is located at the far edge of the beach vegetation type near where it changes vegetation type and the slope increases up the hill.

Community type: Mesic mixed forb herbaceous, 1989.

Loran:

Elevation: 15 feet

10A to 10B: 265°

10B to 10A: 85°

Terrain slope: 5%

Terrain aspect: 10°

Transect 11 Beach Community

General location: For general orientation to the area, see the description for transect 8. Transect 11 is located on the north side of the creek/canyon, roughly paralleling the base of the hill where its slope substantially increases. It is an estimated 75 feet approximately north of the creek.

Community type: Mesic mixed forb herbaceous, 1989.

Loran:

Elevation: 10 feet
11A to 8A: 298°
11A to 11B: 340°
11B to 11A: 160°
Terrain slope: 3%
Terrain aspect: east to northeast (check this)

Transect 12 Beach Community

General location: SE shore of the arrowhead, at mouth of 5th major drainage from tip of arrowhead, on SW side.

Community type: Mesic mixed forb herbaceous, 1989.

Loran:

Elevation:

12A to 12B:

Terrain slope: 2%

Terrain aspect: app. 335 degrees, NNW

Transect 13 Barren Community

General location: Locate the tallest knoll near the southern face of the receding glacier on the southwest corner of the Arrowhead near the water. Knoll 1 at the east end of the Arrowhead has a 124° orientation from knoll 3. Knoll 3 has a longish flat top approximately 150 feet long. At the northwest (300°) end of the knoll 3, locate a cairn by a large greenish rock. In 1989, transect 13 was approximately 1000 feet from the face of the receding glacier.

From transect 13 there is a large waterfall originating from the side of Guyot Glacier at 290°, and to the north/northeast is a steep ridge of barren bedrock coming down from the glacier.

Community type: Barren (< 10% dry seral forb cover, 1989)

Loran: N 60 061 W 141 325

Elevation: 740 feet

Cairn to 13A: 305° 235 feet 27% slope

Cairn to 13B: 324°

13A to 13B: 350°

13B to 13A: 170°

Terrain slope:

Terrain aspect: 290°

Transect 14 Barren Community

General location: See the directions from transect 13 for orientation to transect 14. Travel down an embankment from 13B to get to the terrace transect 14 is located on. The transect is parallel with the orientation of the terrace. The slope down the ledge from transect 14 approaches vertical.

Community type: Barren (< 10% dry seral forb cover, 1989)
 Loran: N 60 061 W 141 325
 Elevation: 720 feet
 13B to 14A: 280° approx 85 to 90 feet (135 feet?)
 14A to 14B: (N to NW verify this)
 14B to 14A: (S to SE verify this)
 Transect slope: 7%
 Terrain slope: 20% Terrain aspect: 290°

DATABASE CODES

D:\FOREST\AROHVEG.DBF (Arrowhead vegetation)
 Record numbers used in the database file for each of ten plots entered on each transect (14 transects) are listed just below the "%" on Vegetation Assessment Data Sheets. There are 5 vegetation types: moss, equis (Equisetum), alder, beach, and barren (barren). A total of 33 species were recorded on the 14 transects.

Species	Acronym	Spp#
Barren	BARREN	1
Litter	LITTER	2
Equisetum arvense	EQUARV	3
Equisetum variegatum subsp. variegatum	EQUVAR	4
Achillea borealis	ACHBOR	5
Aster subspicatus	ASTSUB	6
Alnus crispa subsp. sinuata	ALNCRI	7
Arabis lyrata subsp. kamchatica	ARALYR	8
Honkenya peploides subsp. major	HONPEP	9
Sagina saginoides	SAGSAG	10
Stellaria sp.	STELL	11
Carex aurea	CARAUR	12
Carex Kelloggii	CARKEL	13
Carex maritima	CARMAR	14
Lupinus nootkatensis	LUPNOO	15
Juncus arcticus subsp. sitchensis	JUNARC	16
Epilobium adenocaulon	EPIADE	17
Epilobium latifolium	EPILAT	18
Epilobium leptocarpum	EPILEP	19
Platanthera dilatata	PLADIL	20
Agrostis exarata	AGREXE	21
Agrostis scabra	AGRSCA	22
Elymus arenarius subsp. mollis var. mollis	ELYARE	23
Festuca scabra	FESSCA	24
Phleum commutatum var. americanum	PHLCOM	25
Poa pratensis	POAPRA	26
Salix alaxensis	SALALA	27
Salix sitchensis	SALSIT	28
Parnassia palustris	PARPAL	29
Moss 1 (Rachomitrium)	MOSS 1	30
Moss 2	MOSS 2	31

Lichen (Stereocaulon)
Fungus

LICHEN 32
FUNGUS 33

Moss community

acronym	#	x/30	freq.
BARREN	1	28	93.3
LITTER	2	26	86.7
EQUARV	3	2	6.7
EQUVAR	4	1	3.3
CARAUR	12	1	3.3
CARMAR	13	3	10.0
EPILAT	18	9	30.0
AGREXE	21	1	3.3
AGRSCA	22	4	13.3
FESSCA	24	1	3.3
SALALA	27	6	20.0
SALSIT	28	1	3.3
MOSS 1	30	30	100.0
MOSS 2	31	1	3.3
LICHEN	32	15	50.0

Equisetum Community

BARREN	1	29	96.7
LITTER	2	29	96.7
EQUARV	3	6	20.0
EQUVAR	4	28	93.3
SAGSAG	10	5	16.7
CARAUR	12	4	13.3
CARMAR	13	5	16.7
CARKEL	14	2	6.7
JUNARC	16	9	30.0
EPILAT	18	17	56.7
EPILEP	19	2	6.7
PLADIL	20	1	3.3
AGREXE	21	5	16.7
AGRSCA	22	2	6.7
SALALA	27	4	13.3
SALSIT	28	4	13.3
MOSS 1	30	30	100.0
LICHEN	32	1	3.3

Alder Community

BARREN	1	28	93.3
LITTER	2	30	100.0
EQUARV	3	2	6.7
EQUVAR	4	21	70.0
ALNCRI	7	20	66.7
SAGSAG	10	10	33.3
JUNARC	16	2	6.7
EPIADE	17	4	13.3
EPILEP	19	10	33.3
AGREXE	21	9	30.0
AGRSCA	22	1	3.3
PHLCOM	25	3	10.0
SALALA	27	5	16.7
SALSIT	28	2	6.7
PARPAL	29	3	10.0
MOSS 1	30	30	100.0
MOSS 2	31	8	26.7
LICHEN	32	4	13.3

Beach Community

BARREN	1	30	100.0
LITTER	2	30	100.0
EQUARV	3	10	33.3
EQUVAR	4	8	26.7
ACHBOR	5	1	3.3
ASTSUB	6	1	3.3
ALNCRI	7	2	6.7
ARALYR	8	4	13.3
HONPEP	9	3	10.0
SAGSAG	10	10	33.3
STELL	11	12	40.0
CARMAR	13	1	3.3
CARKEL	14	1	3.3
LUPNOO	15	28	93.3
JUNARC	16	4	13.3
EPIADE	17	17	56.7
EPILAT	18	6	20.0
EPILEP	19	13	43.3
PLADIL	20	2	6.7
AGREXE	21	22	73.3
AGRSCA	22	8	26.7
ELYARE	23	1	3.3
PHLCOM	25	1	3.3
POAPRA	26	3	10.0
SALSIT	28	1	3.3
MOSS 1	30	26	86.7
MOSS 2	31	4	13.3
FUNGUS	33	1	3.3
Barren community			

BARREN	1	30	100.0
LITTER	2	10	50.0
EPILAT	18	14	70.0
MOSS 1	30	20	100.0

Table ?. Moss Community

Species	% x cover	%rel. cover	% freq.	%rel. freq.	impt. value	IV rank
BARREN	20.95		93.33			
LITTER	1.80		86.67			
Shrubs						
SALALA	.35	.42	20.00	7.50	3.96	4
SALSIT	.10	.12	3.33	1.25	.69	9
subtotal	.45					
Forbs						
EQUARV	.20	.24	6.67	2.50	1.37	8
EQUVAR	.10	.12	3.33	1.25	.69	9
EPILAT	3.35	4.00	30.00	11.25	7.63	3
subtotal	3.65					
Graminoids						
CARAUR	.01	.01	3.33	1.25	.63	11
CARMAR	2.60	3.10	10.00	3.75	3.43	6
AGREXE	.10	.12	3.33	1.25	.69	9
AGRSCA	1.95	2.33	13.33	5.00	3.67	5
FESSCA	.10	.12	3.33	1.25	.69	9
subtotal	4.76					
Moss/Lichens						
MOSS 1	73.52	88.00	100.00	37.50	62.75	1
MOSS 2	.02	.02	3.33	1.25	.64	10
LICHEN	1.08	1.29	50.00	18.75	10.02	2
subtotal	74.62					
Other						
FUNGUS	.17	.20	16.67	6.25	3.23	7
TOTAL	83.74		266.65			

Table ?. Equisetum Community

Species	% x cover	%rel. cover	% freq.	%rel. freq.	impt. value	IV rank
BARREN	49.68		96.67			
LITTER	3.93		96.67			
Shrubs						
SALALA	.40	.61	13.33	3.20	1.91	11
SALSIT	.72	1.10	13.33	3.20	2.15	10
Forbs						
EQUARV	.60	.91	20.00	4.80	2.86	6
EQUVAR	19.05	29.00	93.33	22.40	25.70	2
SAGSAG	.33	.50	16.67	4.00	2.25	9
EPILAT	2.42	3.68	56.67	13.60	9.64	3
EPILEP	.20	.30	6.67	1.60	.95	14
PLADIL	.10	.15	3.33	1.80	.55	15
JUNARC	.90	1.37	30.00	7.20	4.29	4
Graminoids						
CARAUR	1.30	1.98	3.33	3.20	2.59	7
CARMAR	.50	.76	16.67	4.00	2.88	5
CARKEL	1.10	1.67	6.67	1.60	1.64	12
AGREXE	.42	.64	16.67	4.00	2.32	8
AGRSCA	.60	.91	6.67	1.60	1.26	13
Moss/Lichens						
MOSS 1	35.78	54.47	100.00	24.00	39.24	1
LICHEN	.02	.03	3.33	.80	.42	16
TOTAL	65.69		4.17			

Table ?. Alder Community

Species	% x cover	%rel. cover	% freq.	%rel. freq.	impt. value	IV rank
BARREN	42.03		93.33			
LITTER	19.77		100.00			
Shrubs						
ALNCRI	23.87	30.68	66.67	14.93	22.81	2
SALALA	.17	.22	16.67	3.73	1.98	8
SALSIT	.60	.77	6.67	1.49	1.13	12
subtotal	24.64					
Forbs						
EQUARV	.60	.77	6.67	1.49	1.13	12
EQUVAR	7.25	9.32	70.00	15.67	12.50	3
SAGSAG	.25	.32	33.33	7.46	3.89	7
EPIADE	.40	.51	13.33	2.98	1.75	9
EPILEP	1.40	1.80	33.33	7.46	4.63	5
PARPAL	.30	.39	10.00	2.24	1.32	10
JUNARC	.20	.26	6.67	1.49	.88	13
subtotal	10.40					
Graminoids						
AGREXE	2.42	3.11	30.00	6.72	4.92	4
AGRSCA	.10	.13	3.33	.75	.44	14
PHLCOM	.22	.28	10.00	2.24	1.26	11
subtotal	2.74					
Moss/Lichens						
MOSS 1	38.20	49.10	100.00	22.39	35.75	1
MOSS 2	1.42	1.83	26.67	6.19	4.01	6
LICHEN	.40	.51	13.33	2.98	1.75	9
subtotal	40.02					
TOTAL	77.80		446.67			

Table ?. Beach Community

Species	% x cover	%rel. cover	% freq.	%rel. freq.	impt. value	IV rank
BARREN	30.48		100.00			
LITTER	17.08		100.00			
Shrubs						
ALNCRI	.52	.39	6.67	1.06	.73	17
SALSIT	.03	.02	3.33	.53	.28	20
subtotal	.55					
Forbs						
EQUARV	8.07	6.10	33.33	5.29	5.70	5
EQUVAR	4.57	3.46	26.67	4.23	3.85	8
ARALYR	.32	.24	13.33	2.12	1.18	13
HONPEP	.30	.23	10.00	1.59	.91	16
SAGSAG	.67	.53	33.33	5.29	2.91	9
STELL	5.10	3.86	40.00	6.35	5.11	6
LUPNOO	51.43	38.91	93.33	14.82	26.87	1
EPIADE	10.68	8.08	56.67	9.00	8.54	4
EPILAT	.83	.63	20.00	3.17	1.90	11
EPILEP	2.90	2.19	43.33	6.88	4.45	7
PLADIL	.50	.38	3.33	.53	.46	18
ACHBOR	.02	.02	3.33	.53	.28	20
ASTSUB	.10	.08	3.33	.53	.31	19
JUNARC	.40	.30	13.33	2.12	1.21	12
subtotal	85.89					
Graminoids						
CARMAR	.10	.08	3.33	.53	.31	19
CARKEL	2.08	1.57	3.33	.53	1.05	15
AGREXE	8.10	6.13	73.33	11.64	8.89	3
AGRSCA	1.20	.91	26.67	4.23	2.57	10
POAPRA	.30	.23	10.00	1.59	.91	16
ELYARE	.10	.08	3.33	.53	.31	19
PHLCOM	.02	.02	3.33	.53	.28	20
subtotal	11.90					
Moss/Lichens						
MOSS 1	33.53	25.37	86.67	13.76	19.57	2
MOSS 2	.22	.17	13.33	2.12	1.15	14
subtotal	33.75					
FUNGUS	.10	.08	3.33	.53	.31	19

TOTAL	132.19		629.96			
Table ?.	Barren Community					
Species	% x cover	%rel. cover	% freq.	%rel. freq.	impt. value	IV rank
BARREN	94.38		100.00			
LITTER	.88		50.00			
Forbs						
EPILAT	5.93	69.68	70.00	41.18	55.43	1
subtotal	5.93					
Mosses						
MOSS 1	2.58	30.32	100.00	58.82	44.57	2
subtotal	2.58					
TOTAL	8.51		170.00			

Species	x	MOSS	(14)			EQUISETUM	(16)			ALDER	(16)
impt.		%		impt.		%		impt.		%	
value	cover	freq.	IV	value	cover	freq.	IV	value	cover	freq.	IV
BARREN	20.95	93.33			49.68	96.67			42.03	93.33	
LITTER	1.80	87.67			3.93	96.67			19.77	100.00	
MOSS 1	73.52	100.00	1	62.75	35.78	100.00	1	39.24	38.20	100.00	1
35.75											
LICHEN	1.08	50.00	2	10.02	.02	3.33	16	.42	.40	13.33	9
1.75											
EPILAT	3.35	30.00	3	7.63	2.42	56.57	3	9.64			
SALALA	.35	20.00	4	3.96	.40	13.33	11	1.91	.17	16.67	8
1.98											
AGRSCA	1.95	13.33	5	3.67	.60	6.67	13	1.26	.10	3.33	14
.44											
CARMAR	2.60	10.00	6	3.43	.50	16.67	5	2.88			
FUNGUS	.17	16.67	7	3.23							
EQUARV	.20	6.67	8	1.37	.60	20.00	6	2.86	.60	6.67	12
1.13											
FESSCA	.10	3.33	9	.69							
EQUVAR	.10	3.33	9	.69	19.05	93.33	2	25.70	7.25	6.67	3
12.50											
AGREXE	.10	3.33	9	.69	.42	16.67	8	2.32	2.42	30.00	4
4.92											
SALSIT	.10	3.33	9	.69	.72	13.33	10	2.15	.60	6.67	12
1.13											
MOSS 2	.02	3.33	10	.64					1.42	26.67	6
4.01											
CARAUR	.01	3.33	11	.63	1.30	13.33	7	2.59			
JUNARC					.90	30.00	4	4.29	.20	6.67	13
.88											
SAGSAG					.33	16.67	9	2.25	.25	33.33	7
3.89											
CARKEL					1.10	6.67	12	1.64			
EPILEP					.20	6.67	14	.95	1.40	33.33	5
4.63											
PLADIL					.10	3.33	15	.55			
ALNCRI									23.87	66.67	2
22.81											
EPIADE									.40	13.33	9
1.75											
PARPAL									.30	10.00	10
1.32											
PHLCOM									.22	10.00	11

1.26

total	83.74	266.65	66.19	416.67	77.80	446.67
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Species impt. value	BARREN (2)			MOSS (14)				ALDER (16)	
	x	%	impt.	x	%	impt.		x	%
	cover	freq. IV	value	cover	freq.	IV	value	cover	freq. IV
BARREN	94.38	100.00		20.95	93.33			42.03	93.33
LITTER	.88	50.00		1.80	86.67			19.77	100.00
EPILAT	5.93	70.00	1 55.43	3.35	30.00	3 7.63			
MOSS 1	2.58	100.00	2 44.57	73.52	100.00	1 62.75		38.20	100.00
1 35.75									
LICHEN				1.08	50.00	2 10.02		.40	13.33
9 1.75									
SALALA				.35	20.00	4 3.96		.17	16.67
8 1.98									
AGRSCA				1.95	13.33	5 3.67		.10	3.33
14 .44									
CARMAR				2.60	10.00	6 3.43			
FUNGUS				.17	16.67	7 3.23			
EQUARV				.20	6.67	8 1.37		.60	6.67
12 1.13									
FESSCA				.10	3.33	9 .69			
EQUVAR				.10	3.33	9 .69		7.25	6.67
3 12.50									
AGREXE				.10	3.33	9 .69		2.42	30.00
4 4.92									
SALSIT				.10	3.33	9 .69		.60	6.67
12 1.13									
MOSS 2				.02	3.33	10 .64		1.42	26.67
6 4.01									
CARAUR				.01	3.33	11 .63			
ALNCRI								23.87	66.67
2 22.81									
EPILEP								1.40	33.33
5 4.63									
SAGSAG								.25	33.33
7 3.89									
EPIADE								.40	13.33
9 1.75									
PARPAL								.30	10.00
10 1.32									
PHLCOM								.22	10.00
11 1.26									
JUNARC								.20	6.67
12 1.13									

total	8.51	170.00	83.74	266.65	77.80	446.67
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Beach Community (25 species)

Species	x cover	% freq.	impt. value	IV rank
BARREN	30.48	100.00		
LITTER	17.08	100.00		
LUPNOO	51.43	93.33	26.87	1
MOSS 1	33.53	86.67	19.57	2
AGREXE	8.10	73.33	8.89	3
EPIADE	10.68	56.67	8.54	4
EQUARV	8.07	33.33	5.70	5
STELL	5.10	40.00	5.11	6
EPILEP	2.90	43.33	4.45	7
EQUVAR	4.57	26.67	3.85	8
SAGSAG	.67	33.33	2.91	9
AGRSCA	1.20	26.67	2.57	10
EPILAT	.83	20.00	1.90	11
JUNARC	.40	13.33	1.21	12
ARALYR	.32	13.33	1.18	13
MOSS 2	.22	13.33	1.15	14
CARKEL	2.08	3.33	1.05	15
HONPEP	.30	10.00	.91	16
POAPRA	.30	10.00	.91	16
ALNCRI	.52	6.67	.73	17
PLADIL	.50	3.33	.46	18
ASTSUB	.10	3.33	.31	19
CARMAR	.10	3.33	.31	19
ELYARE	.10	3.33	.31	19
FUNGUS	.10	3.33	.31	19
SALSIT	.03	3.33	.28	20
ACHBOR	.02	3.33	.28	20
PHLCOM	.02	3.33	.28	20
total	132.19	629.96		

Soil Analysis Results

Sample #	pH	Ammonium (ppm)	Nitrate + (ppm)	Total Nitrogen =	Phosphorus (ppm)	Potassium (ppm)	% Org. Matter
Moss							
1	8.18	4	<1	4	5	91	0.47
2	8.17	4	<1	4	6	71	0.47
Equisetum							
4	7.97	3	<1	3	12	51	0.27
5	8.02	3	<1	3	4	42	0.27
Alder							
7	6.46	5	<1	5	9	13	0.13
8	8.16	4	<1	4	3	77	0.54
9	6.89	3	<1	3	10	25	0.20
Beach							
10	7.72	4	<1	4	13	61	0.54
11	6.07	5	11	16	8	83	3.25
Barren							
14	8.46	4	<1	4	4	41	0.20

Sample #	% sand	% silt	% clay
Moss			
1	17.6	54.4	28.0
2	43.6	34.4	22.0
Equisetum			
4	52.0	18.4	29.6
5	62.0	6.4	31.6
Alder			
7	84.0	12.4	3.6
8	34.0	38.8	27.2
9	72.0	20.4	7.6
Beach			
10	52.0	26.4	21.6
11	50.4	37.2	12.4
Barren			
14	54.8	33.2	12.0

Analysis done by the Plant and Soils Laboratory, Agriculture & Forestry Experimental Station in Palmer, AK.

Table C. Equisetum Community

Species	% x cover	%rel. cover	% freq.	%rel. freq.	impt. value	IV rank
BARREN	49.68		96.67			
LITTER	3.93		96.67			
Shrubs						
SALALA	.40	.61	13.33	3.20	1.91	11
SALSIT	.72	1.10	13.33	3.20	2.15	10
subtotal	1.12					
Forbs						
EQUARV	.60	.91	20.00	4.80	2.86	6
EQUVAR	19.05	29.00	93.33	22.40	25.70	2
SAGSAG	.33	.50	16.67	4.00	2.25	9
EPILAT	2.42	3.68	56.67	13.60	9.64	3
EPILEP	.20	.30	6.67	1.60	.95	14
PLADIL	.10	.15	3.33	1.80	.55	15
JUNARC	.90	1.37	30.00	7.20	4.29	4
subtotal	23.60					
Graminoids						
CARAUR	1.30	1.98	3.33	3.20	2.59	7
CARMAR	.50	.76	16.67	4.00	2.88	5
CARKEL	1.10	1.67	6.67	1.60	1.64	12
AGREXE	.42	.64	16.67	4.00	2.32	8
AGRSCA	.60	.91	6.67	1.60	1.26	13
subtotal	3.92					
Moss/Lichens						
MOSS 1	35.78	54.47	100.00	24.00	39.24	1
LICHEN	.02	.03	3.33	.80	.42	16
subtotal	35.80					
TOTAL	65.69		416.67			

Table F. Shrubs > .31 m (1 ft.) tall.

Species	% x cover	%rel. cover	% freq.	%rel. freq.	density shrb/ha	% rel. density	impt. value	IV rank
Moss Community								
SALSIT	1.90	26.67	50.00	53.57	599.9	50.00	43.41	1
SALALA	4.63	64.94	23.33	25.00	400.0	33.34	41.09	2
SALCOM	.40	5.61	13.33	14.28	133.3	11.11	10.33	3
ALNCRI	.20	2.81	6.67	7.15	66.7	5.56	5.17	4
total	7.13		93.33		1199.9			
Equisetum Community								
SALSIT	.32	51.61	13.33	57.14	233.3	50.00	52.92	1
SALALA	.30	48.39	10.00	42.86	233.3	50.00	47.08	2
total	.62		23.33		466.6			
Alder Community								
ALNCRI	65.00	87.93	100.00	52.63	17798.2	92.55	77.70	1
SALALA	4.12	5.57	47.67	24.56	633.3	3.29	11.14	2
SALSIT	1.52	2.06	27.67	14.04	533.3	2.77	6.29	3
POPTRI	2.68	3.63	10.00	5.26	133.3	.69	3.19	4
SALCOM	.60	.81	6.67	3.51	133.3	.69	1.67	5
total	73.92		190.01		19231.4			

Objectives of the trip to Yakutat: (8/21 to 8/31)

To survey the shoreline around "the Arrowhead" for signs of human use: campsites, garbage, etc.

To relocate/establish several photopoints for long-term glacier monitoring:
B/47 on the Arrowhead
A/46 at Chaix Hills north of Colossal Cr.
(special helicopter support required, Note shutter speed, aperture, ht. AGL, position,

Note locations of inter-stadial forest remains.

Relocate/map airstrip.

Make wildlife observations.

Gather information in support of the oilspill contingency management plan (critical resources, beach slopes, etc. in the vicinity of the arrowhead)

Establish long term vegetation monitoring transects on the Arrowhead to look at plant succession after glacial retreat. Species list, species frequencies, cover %, richness, evenness v.s. patchiness,

Comments:

Photo numbers

Soil samples

Wildlife

Disseminule type of colonizers

Ice free est.

Rhizocarpon/Umbilicaria

Proximity from "Undisturbed Forest"

Elevation of Arrowhead top

Width and Length (miles)

Soil contouring

The Arrowhead is located on the western shore of Icy Bay. It is surrounded by ocean on its east, south and northern sides and the ice of Guyot Glacier to the west; it is not contiguous with any other land. The Arrowhead is approximately 2 miles wide and 4 (6) miles long and continues to expand in size as the Guyot Glacier recedes. It ranges from 0 to approximately 1000 feet in elevation. There is a slab of remnant glacial ice which is melting into a lake at the top of the Arrowhead.

Research Natural Area information

Point Quarter Method data sheet

Tree ages on the Malaspina Forelands

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