Ecological Subsections of Katmai National Park & Preserve, Alagnak Wild River

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Introduction

The purpose of this report is to provide a map and descriptions of the coarse-scale ecological units for Katmai National Park and Preserve. The objective is to furnish the park with landscape stratification maps following the ecological land classification system (ECOMAP) at approximately the subsection scale (ECOMAP 1993).

Multiple factors are used to delineate ecosystems in the discipline of ecosystem geography (Bailey 1996). The multiple factors used in this case include bedrock and surficial geology maps, multi-spectral satellite imagery, and color infarred aerial photography where available. To map the Ecological Subsections we used a map scale of 1:250,000. This will provide a generalized ecosystem map for the park that can be used for stratification of vegetation and species-level sampling as well as facilitate cover type mapping.

No fieldwork was done to delineate these ecological units, the information was entirely from existing remote imagery, selected reports and personal communications from available experts. If the park so chooses this map can be refined and the next layer of mapping, the Landtype Associations can be added hierachically underneath these ecological units.

These ecological units are necessarily broad. They are composed of repeating patterns of soil and vegetation. What makes one different from another, is that the distribution and abundance of the community types within the units are different. There will be many units that contain the same vegetation community. But their distribution will be different in different Subsections.

Methods

The Thematic mapper image of the park at roughly 1:250,000 scale was used as the base layer. Surficial and bedrock geology maps were examined carefully and various references reviewed (Griggs 1922, Cahalane 1959, Young and Racine 1978, Kaufman and Stilwell 1997). Units were then delineated on a rough 'concept-level' map using the TM image as the background. This map was then reviewed with David K. Swanson (NRCS) and Jim Riehle (USGS), one of the authors of the bedrock and surficial geology maps for the Mt. Katmai quadrangle. Concepts were then refined and the final mapping was completed on mylar over the mylar 1:250,000 quadrangle maps (Karluk, Mt. Katmai, Naknek, Dillingham, Iliamna, and Afognak). The Thematic image or one of the geology maps, whichever best reflected the primary delineating criteria for each line was used as the basis of line placement. Color infrared aerial photography was consulted when the 1:250,000 scale information sources did not provide enough information. When one or more of these factors (Gross physiography, Lithology, and Surficial geology) changed dramatically so that there is a sharp ecotonal boundary, we used the boundary as a delineation between ecological subsections.

These mylar overlays were then scanned, merged into a single georeferenced coverage in ARC/INFO.

Delineation Rational

Minimum size has not been defined for this project. Recommended size range is generally between 1,000s and 10's of square miles (ECOMAP 1993). These subsections fall within that range.

'Detailed subsections' or subdivisions of the subsections following Swanson (1999) for Yukon-Charley National Preserve have also been delineated for three of the 20 subsections. These subdivisions could form the beginning of Landtype Association mapping if the Park so desires. These subdivisions were delineated for only these three subsections (Walatka Mountains, Kamishak River Hills, and the South Kegulik Mountains) because of their smooth and clear

ecotone boundary between the tundra dominated alpine areas and the alder shrub dominated valley bottoms. The other subsections all had appreciably more convolutedness with any potential subunits, and thus could not be delineated at this scale.

A couple of the assumptions used with this mapping are as follows:
1. The units should be process-driven, meaning if there was a process that formed a specific feature with repeating patterns of vegetation communities across it, and if it is large enough at this scale of mapping, then it would be delineated. A couple of examples are the large moraine systems, Lacustrine deposits and where the age of the land is very different.

2. If it looks like the vegetation communities are similar (ie lacustrine and undifferentiated drift) but the distribution and abundance of the community types within the units are different, then they should be separate units, and not lumped.

The next layer down within the hierachy of nested ecosystems (or ecological units), is the Landtype Association uses soil great groups and soil suborders, plant association series and other vegetation information, as well as the lithology, surficial geology and physiography. It also requires fieldwork. The Ecological Subsection mapping is primarily based on the three items mentioned above with no fieldwork. The level above, the ecoregion level, uses coarse-scale climatic information as one of the main delineators and coarse-scale geology maps (See ECOMAP 1993).

The rational for the Ecological Subsections has been described in brief to assist people to understand the thinking behind the delineations, this information has also been included directly in the attribute table with (Table 1).

The ecoregional naming and mapping was taken from Nowacki et al. (in prep). Katmai is divided into two main Ecoregions, the Bristol Bay lowlands in the western 1/4 of the park and the Alaska Peninsula for the rest.

The Bristol Bay Lowlands Ecoregion is composed of older Pleistocene drift (moraines, outwash, lacustrine deposits etc that are all cloaked in varying amounts of loess). Discontinous permafrost occurs throughout the Bristol Bay Lowlands.

The Alaska Peninsula Ecoregion is composed of the younger, better defined, Pleistocene moraines that confine the present extent of the lakes in the region, and the bedrock controlled areas of the Alaska Peninsula. Some of the most active volcanoes on the continent occur in and help define this Section. Holocene and older volcanics, and sedimentary rocks dominate, but there a few locations of plutonic rocks.

Table 1. Symbols and delineation rational for the Ecological Subsections of Katmai.

Symbol	Delineation rational
ARD	Undifferentiated outwash and drift with surface/groundwater flow features that seem to be determining vegetation and soil patterns.
BBL	Pleistocene drift with discontinuous permafrost and a mantle of loess up to 2 meters deep.
BRN	Tertiary-aged volcanics, dissected by past glacial activity. Steep-walled fjords with few to no lowlands. (Sediment probably deposited at coast now 100m or more below sea-level.) Bare ash zones still evident along ridges and mountainsides.
BRS	Tertiary-aged volcanics, dissected by past glacial activity. Steep-walled fjords with few to no lowlands. (Sediment probably deposited at coast now 100m or more below sea-level.) Bare ash zones still evident along ridges and mountainsides.
CDM	Recent Volcanoes and a mix of plutonic and sedimentary rocks capped by numerous active glaciers.
CLD	Pleistocene and Holocene lake deposits, primarily in intramoraine basins. A mix of fine grained deposits and coarser-grained terraces.
IDD	Pleistocene Drift deposits, predominately moraines with numerous kettles. Primarily of the Iliamna advance.
KEM	Recent Volcanoes and lava flows. Tuffs, flows etc. of Holocene and Pleistocene age. Also covered by numerous active glaciers.
KLM	Ground Moraine and drift dominated area.
KRF	Katmai River Floodplain system choked with ash from the 1912 eruption. Aggrading system with lots of quicksand.
KRH	Low rolling hills and valleys scoured by ice during the Pleistocene.
LOD	Undifferentiated outwash and drift with surface/groundwater flow features that seem to be determining vegetation and soil patterns.
LRD	Pleistocene and Holocene lake deposits, primarily in intramoraine basins. A mix of fine grained deposits and coarser-grained terraces.
LRH	Rounded bedrock foothills (500-3,000 ft) of mixed lithology that are partially till covered. Solifluction lobes are common.
LRM	Moraines, Till and and Colluvial deposits with the furthest Southwest stand of white spruce.
SKM	Mixed lithology (volcanic and sedimentary) area that has been heavily glaciated during the Pleistocene (otherwise resemble Kegulik mtns subsection).
SRF	Large active aggrading river system with white spruce. Overbank silt deposits dominated by various wetlands. Young White Spruce stands have developed on well-drained surfaces. Part of the largest drainage basin in the park.
SSL	Coastal Lowland complex of beach, estuarine, outwash and alluvial deposits. Associated with streams with high sediment loads-either glacial or volcanic or both.
TTS	Pyroclastic flows and ash from the 1912 eruption.
WAM	Angular sedimentary and granitic mountains that are 3,000 to 5,000 feet. Neoglaciation has formed numerous cirques, eretes, and horns.

Discussion

The number of polygons for this mapping is quite small. There are only 41 polygons of Subsections (Table 2) and 76 polygons total when counting all the detailed subsections (Table 3). Most of the map units repeat rarely except for the Lakes Region Hills and the Shelikof Strait Lowlands, both of which are scattered across a wider area (Table 1). The attribute table has 588 polygons, due to the myriad of small islands along the coast. The smallest polygon that lies wholly within the park is the Coville Lake Deposits at 29,600 acres. Fragments of two polygons, the Alagnak River Lowlands and the Bristol Bay Lowlands occur within the park, but are very extensive to the west of the park boundary (Figure 1). The average size of the map units (excluding ARD and BBL which are not well represented in the park) is about 227,000 acres. The average size by polygon is about 104,600 acres (Table 2).

Three of the four largest Subsections (by area) have been split into detailed subsections (Table 3). The methods section describes how this detailed subsection delineation process occurred. This results in almost doubling the number of polygons in the mapping cover (Table 3).

A hierarchical classification for Alaskan Subsections has been organized and used to assist in grouping subsections upward into meaningful units (Table 4). At the coarsest scale Katmai can be divided in half between the Angular Mountains and the Hills and Plains –this is approximately the line that is followed at the ecological regions level of work (Nowacki et al. in prep). As this mapping is completed for all the parks and national forest areas around the state, we will begin to get an appreciation of the distribution and abundance of subsection types across the state. For example, we know that Quaternary igneous areas of this size (One of the main reasons this park was established) are rare in the state and country other notable patterns will also emerge.

Table 2. The full name, number of polygons, and acres of the Subsections within Katmai National Park and Preserve.

SUBSECTION NAME	Subsection Abbreviation	Number of Polygons	Acres
Alagnak River lowlands	ARD	1	1751
Bristol Bay lowlands	BBL	1	8417
Barrier Range Mountains –North	BRN	1	65575
Barrier Range Mountains –South	BRS	2	294008
Cape Douglas Mountains	CDM	1	282423
Coville Lake Deposits	CLD	1	29651
Iliamna Drift deposits	IDD	1	66210
Kegulik Mountains	KEM	2	364163
Kukaklek Lake Moraines	KLM	2	236374
Katmai River floodplain	KRF	1	26850
Kamishak River Hills	KRH	1	566505
Lowland outwash and drift deposits	LOD	1	133087
Lakes Region old lake bed deposits	LRD	2	145398
Lakes Region Hills	LRH	10	364157
Lakes Region Spruce covered Moraines	LRM	1	433962
South Kegulik Mountains	SKM	2	417953
Savonski River floodplain and terraces	SRF	1	95111
Shelikof Strait Lowlands	SSL	8	102424
Valley of Ten Thousand Smokes	TTS	1	55100
Walatka Mountains	WAM	1	401003
	Total	41	4090124

Table 3. The Detailed Subsections of Katmai National Park and Preserve, number of polygons and acres of each.

Detailed Subsection Name	Detailed Subsections	Number of Polygons	Acres
Alagnak River lowlands	ARD	1	1751.1
Bristol Bay lowlands	BBL	1	8416.9
Barrier Range Mountains –North	BRN	1	65575.3
Barrier Range Mountains –South	BRS	2	294007.6
Cape Douglas Mountains	CDM	1	282423.2
Coville Lake Deposits	CLD	1	29650.8
Iliamna Drift deposits	IDD	1	66210.2
Kegulik Mountains	KEM	2	364163.4
Kukaklek Lake Moraines	KLM	2	236374.1
Katmai River floodplain	KRF	1	26850.1
Kamishak River Hills –Highlands	KRH1	11	191003.6
Kamishak River Hills –Valley Bottoms	KRH2	1	375501.0
Lowland outwash and drift deposits	LOD	1	133086.9
Lakes Region old lake bed deposits	LRD	2	145398.4
Lakes Region Hills	LRH	10	364157.4
Lakes Region Spruce covered Moraines	LRM	1	433962.0
South Kegulik Mountains –Ridges	SKM1	9	189690.7
South Kegulik Mountains –Valleys	SKM2	2	228262.4
Savonski River floodplain and terraces	SRF	1	95111.0
Shelikof Strait Lowlands	SSL	8	102424.5
Valley of Ten Thousand Smokes	TTS	1	55100.3
Walatka Mountains –Highlands	WAM1	11	266219.0
Walatka Mountains -Valley Bottoms	WAM2	5	134784.3
	Grand Total	76	4090124.4

A very coarse-scale landcover map was generated for a 40 million acre area of Bristol Bay in 1981 (Wibbenmyer, Grunblatt and Shea 1982). A new landcover map will be produced for the park in the next year once it is completed. The landcover classes can be compared with the Subsections for reporting. A few broad generalizations can be made contrasting the current landcover map with subsection polygons (Table 5 and 6). For example the Barrier Range Mountains –South has a higher percentage on area in the

snow/cloud/light/barren (in this case probably much of it is probably bare ash) and barren classes and less in the closed shrub graminoid than the Barrier Range Mountains-North. This corroborates the difference between these subsections.

Table 4. The categorization of subsections of Katmai according to the Hierarchical Classification for Alaskan Subsections

(Using gross physiography and lithology).

PHYSIOGRAPHY	LITHOLOGY	Subsection Symbol	Total Acres
Angular Mtns	Igneous Quaternary	KEM	364163
	Igneous Quaternary Total		364163
	Igneous Tertiary	BRN	65575
		BRS	294008
	Igneous Tertiary Total		359583
	Sedimentary Undivided	CDM	282423
		SKM	417953
		WAM	401003
	Sedimentary Undivided Total		1101380
Angular Mtns Total			1825126
Hills & Plain	Drift Deposits	ARD	1751
		BBL	8417
		IDD	66210
		LOD	133087
	Drift Deposits Total		209465
	Holocene Alluvium	KRF	26850
		SRF	95111
	Holocene Alluvium Total		121961
	Holocene Coastal deposits	SSL	102424
	Holocene Coastal deposits Total		102424
	Igneous Quaternary	TTS	55100
	Igneous Quaternary Total		55100
	Lacustrine Deposits	CLD	29651
		LRD	145398
	Lacustrine Deposits Total		175049
	Moraine Deposits	KLM	236374
		LRM	433962
	Moraine Deposits Total		670336
	Sedimentary Noncarbonate	KRH	566505
	Sedimentary Noncarbonate Total		566505
	Undivided Bedrock	LRH	364157
	Undivided Bedrock Total		364157
Hills & Plain Total			2264998
Grand Total			4090124

Table 5. The preliminary Landcover types

(Wibbenmeyer et al. 1982) from 80 meter MSS data resampled to 50 meters for Katmai National Park and Preserve. Acre numbers are low for units BRN, BRS, SSL because the Karluk Quadrangle landcover layer was unavailable.

	Deep Clear Water	Shallow/Sedimented Water	Snow/Cloud/Light Barren	Barren	Mountain Shadow	Marsh/Very Wet Bog	Wet Bog/Wet Meadow'	Conifer Forest	Mixed Forest	Miscellaneous Deciduous (Open Alder, Cottonwood, Birch, Willow)	Closed Shrub Graminoid	Open Low Shrub Eric./Conifer Woodland/Mes.Bog/Eric.Shrub Tundra	Open Low Shrub Gramin./Mesic Bog/Gramin. Shrub Tundra	Lichen Shrub Tundra	Lichen	Total Acres
ARD	0	0	0	0	0	90	0	614	175	83	0	326	191	6	0	1484
BBL	10	0	8	0	0	18	64	935	2274	1454	95	1879	1838	187	72	8832
BRN	309	12	20233	8191	1603	30	62	971	790	3475	23863	555	693	897	572	62257
BRS	808	711	103770	51805	6366	507	848	1526	2304	9322	56904	2339	3233	5238	3923	249603
CDM	463	1439	218781	27298	3199	185	481	34	32	1746	16658	1439	327	1907	1352	275340
CLD	738	0	0	256	0	710	97	7630	3752	322	0	15227	460	449	16	29656
IDD	1845	18	0	41	1	583	2022	321	3318	15255	1635	4434	31936	3622	73	65103
KEM	603	2242	285772	42186	4432	296	183	259	357	4093	15939	812	1325	3545	2154	364198
KLM	45671	0	3372	343	131	6885	809	638	2082	8353	22632	13100	83860	39314	8957	236147
KRF	3	8861	1948	14262	74	328	22	137	74	297	364	217	51	109	15	26762
KRH1	506	689	148352	32710	2936	658	12	151	101	173	300	886	158	1732	1771	191135
KRH2	1999	2177	76555	61224	4350	2963	3014	3038	4396	25137	149802	8954	8771	12051	12066	376496
LOD	754	254	2	5855	15	558	1098	103	368	4139	7560	7027	83019	22126	754	133632
LRD	77092	111	0	383	193	650	1870	542	4870	14602	666	7824	36068	693	0	145564
LRH	8058	1651	111	3077	2307	660	2000	8331	16703	61505	91147	17748	102830	38238	11009	365374
LRM	118273	16793	44	2572	2297	11414	4863	94964	47045	37071	13222	64553	18719	2777	190	434797
SKM1	262	363	40279	64627	13312	547	33	4705	442	2672	9931	6252	11129	18936	17055	190544
SKM2	72	1846	3623	20748	2762	1996	2203	10629	15520	23630	72983	18251	29606	14925	9262	228056
SRF	1466	8134	242	13409	93	3540	6779	12360	12512	25305	5220	4615	956	387	90	95109
SSL	991	5164	2852	13616	275	4000	12262	833	2136	16958	17518	3542	6292	1938	406	88781
TTS	0	667	28307	24343	1035	46	5	0	0	0	3	242	210	199	39	55096
WAM1	1576	964	97309	63104	22951	4106	44	1306	647	1764	8423	8779	10543	21995	24497	268007
WAM2	15075	222	7804	10577	4610	1200	695	2131	2538	15688	53189	5041	8748	4852	3237	135605
Total	276574	52317	1039361	460626	72940	41971	39464	152155	122434	273044	568052	194043	440963	196123	97509	4027577

Table 6. The Percentage of the preliminary Landcover types

(Wibbenmeyer et al. 1982) from 80 meter MSS data resampled to 50 meters for each Ecological Subsection for Katmai National Park and Preserve. Percentages are incorrect for units BRN, BRS, SSL because the Karluk Quadrangle landcover layer was unavailable.

	Deep Clear Water	Shallow/Sedimented Water	Snow/Cloud/Light Barren	Barren	Mountain Shadow	Marsh/Very Wet Bog	Wet Bog/Wet Meadow'	Conifer Forest	Mixed Forest	Miscellaneous Deciduous (Open Alder, Cottonwood, Birch, Willow)	Closed Shrub Graminoid	Open Low Shrub Eric./Conifer Woodland/Mes.Bog/Eric. Shrub Tundra	Open Low Shrub Gramin./Mesic Bog/Gramin. Shrub Tundra	Lichen Shrub Tundra	Lichen	Total Acres
ARD	0%	0%	0%	0%	0%	6%	0%	41%	12%	6%	0%	22%	13%	0%	0%	100%
BBL	0%	0%	0%	0%	0%	0%	1%	11%	26%	16%	1%	21%	21%	2%	1%	100%
BRN	0%	0%	32%	13%	3%	0%	0%	2%	1%	6%	38%	1%	1%	1%	1%	100%
BRS	0%	0%	42%	21%	3%	0%	0%	1%	1%	4%	23%	1%	1%	2%	2%	100%
CDM	0%	1%	79%	10%	1%	0%	0%	0%	0%	1%	6%	1%	0%	1%	0%	100%
CLD	2%	0%	0%	1%	0%	2%	0%	26%	13%	1%	0%	51%	2%	2%	0%	100%
IDD	3%	0%	0%	0%	0%	1%	3%	0%	5%	23%	3%	7%	49%	6%	0%	100%
KEM	0%	1%	78%	12%	1%	0%	0%	0%	0%	1%	4%	0%	0%	1%	1%	100%
KLM	19%	0%	1%	0%	0%	3%	0%	0%	1%	4%	10%	6%	36%	17%	4%	100%
KRF	0%	33%	7%	53%	0%	1%	0%	1%	0%	1%	1%	1%	0%	0%	0%	100%
KRH1	0%	0%	78%	17%	2%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	100%
KRH2	1%	1%	20%	16%	1%	1%	1%	1%	1%	7%	40%	2%	2%	3%	3%	100%
LOD	1%	0%	0%	4%	0%	0%	1%	0%	0%	3%	6%	5%	62%	17%	1%	100%
LRD	53%	0%	0%	0%	0%	0%	1%	0%	3%	10%	0%	5%	25%	0%	0%	100%
LRH	2%	0%	0%	1%	1%	0%	1%	2%	5%	17%	25%	5%	28%	10%	3%	100%
LRM	27%	4%	0%	1%	1%	3%	1%	22%	11%	9%	3%	15%	4%	1%	0%	100%
SKM1	0%	0%	21%	34%	7%	0%	0%	2%	0%	1%	5%	3%	6%	10%	9%	100%
SKM2	0%	1%	2%	9%	1%	1%	1%	5%	7%	10%	32%	8%	13%	7%	4%	100%
SRF	2%	9%	0%	14%	0%	4%	7%	13%	13%	27%	5%	5%	1%	0%	0%	100%
SSL	1%	6%	3%	15%	0%	5%	14%	1%	2%	19%	20%	4%	7%	2%	0%	100%
TTS	0%	1%	51%	44%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
WAM1	1%	0%	36%	24%	9%	2%	0%	0%	0%	1%	3%	3%	4%	8%	9%	100%
WAM2	11%	0%	6%	8%	3%	1%	1%	2%	2%	12%	39%	4%	6%	4%	2%	100%
Total	7%	1%	26%	11%	2%	1%	1%	4%	3%	7%	14%	5%	11%	5%	2%	100%

Ecological Unit Descriptions

ARD Alagnak River Lowlands

Ecoregion: Bristol Bay Lowlands

Geology and physiography: Quaternary river terraces, Pleistocene outwash and older river terraces predominate within this subsection. Loess deposits are common on the older surfaces.

Elevation: 200-400 feet

Vegetation/land cover: Dry tundra (Mat and cushion; Lichen heath) and Moist tundra (Dwarf shrub; Tussock meadow) are some of the most common vegetation types (Young and Racine 1976).

Notes: At a coarse-scale the vegetation seems to reflect groundwater movement, which is tied to the older outwash deposits. This subsection is similar to unit LOD south of Naknek Lake.

BBL Bristol Bay Lowlands

Ecoregion: Bristol Bay Lowlands

Geology and physiography: Early Pleistocene outwash and undifferentiated drift predominate within this subsection. Loess deposits (up to 6 ft) blanket these older Pleistocene surfaces. Thermokarst activity is common.

Elevation: 50-200 feet

Vegetation/land cover: This area is a mosaic of moist tundra (Dwarf shrub and Sedge Tussock Meadow), dry tundra (Mat and cushion; lichen heath), and very open white spruce woodland (Young and Racine 1976).

Notes: This area has thousands of small thermokarst lakes and ponds. Thick loess deposits and the thermokarst activity have muted the more obvious glacial morphological features.

BRN Barrier Range North

No Photo

Ecoregion: Alaska Peninsula

Geology and physiography: Late Tertiary-aged andesitic flows and volcanic tuffs etc. that have been more recently sculpted by glaciers. The eruption of 1912 deposited up to 3 feet of ash in this area. In subsection BRS, 3-6 feet were deposited.

Elevation: 0-2500 feet

Vegetation/land cover: The lower slopes are covered by thick alder stands. Within these stands and Barclay and Alaska willow and salmonberry are common. Gaps are common, and are primarily composed of bluejoint and forbs such as fireweed (based on 49 plots -Smith 1998).

Notes: There are a paucity of lowland depositional features within this unit and BRS, in contrast, the coast area to the north has many coastal lowlands. Because of the lesser amount of ash deposited in this area the vegetation has recovered more quickly. The subalpine area hos only pockets of bare ash while in BRS there are large areas of ash still unvegetated in the subalpine.

BRS Barrier Range South

Ecoregion: Alaska Peninsula

Geology and physiography: Late Tertiary-aged andesitic flows and volcanic tuffs etc. that have been more recently sculpted by glaciers. The eruption of 1912 deposited 3-6 feet of ash in this subsection, while in BRN 3 ft or less were deposited.

Elevation: 0-2500 feet

Vegetation/land cover: The lower slopes are covered by thick alder stands. Within these stands Barclay willow, Alaska willow, and salmonberry are common. Gaps are common, and are primarily composed of bluejoint and forbs such as fireweed. The Subalpine areas are still covered with large areas of bare ash from the 1912 eruption (Smith 1998).

Notes: There are a paucity of lowland depositional features within this unit and BRN. In contrast, the coast to the north has many lowlands such as those within SSL. . Because of the amount of ash deposited in this area the vegetation has recovered slowly. There are large areas of ash still unvegetated in the subalpine. There are also numerous 'ash slides' along ephemeral channels on the steeper lower slopes.

CDM Cape Douglas Mountains

Ecoregion: Alaska Peninsula

Geology and physiography: A mixture of recent volcanics, subvolcanic intrusive bodies, and sedimentary rocks all capped by a small ice sheet.

Elevation: 0 to 6700 feet

Vegetation/land cover: Much of this subsection is covered with snow and ice. Subalpine vegetation and closed shrublands cover much of the rest of the area.

Notes: Somewhat similar to KEM, but KEM is nearly pure volcanics and ice that received a huge influx of ash from the 1912 eruption, while this unit is a mix of lithology types and only received a dusting of ash during the 1912 eruption.

CLD Coville Lake Deposits

Ecoregion: Alaska Peninsula

Geology and physiography: Lacustrine deposits in the former lake bed bounded by the Illiamna-aged moraine.

Elevation: 100-450 ft

Vegetation/land cover: This area is a large wetland complex interspersed with forested islands stringers. Ericaceous heath with scattered white spruce is common (Wibbenmeyer et al. 1982).

Notes: Similar to LRD subsection adjacent to Naknek and Brooks Lakes. CLD is much more in the forested zone than LRD. LRD has many old lake shore terraces interspersed within the matrix of lacustrine deposits while CLD does not.

IDD Iliamna Drift Deposits

Ecoregion: Alaska Peninsula

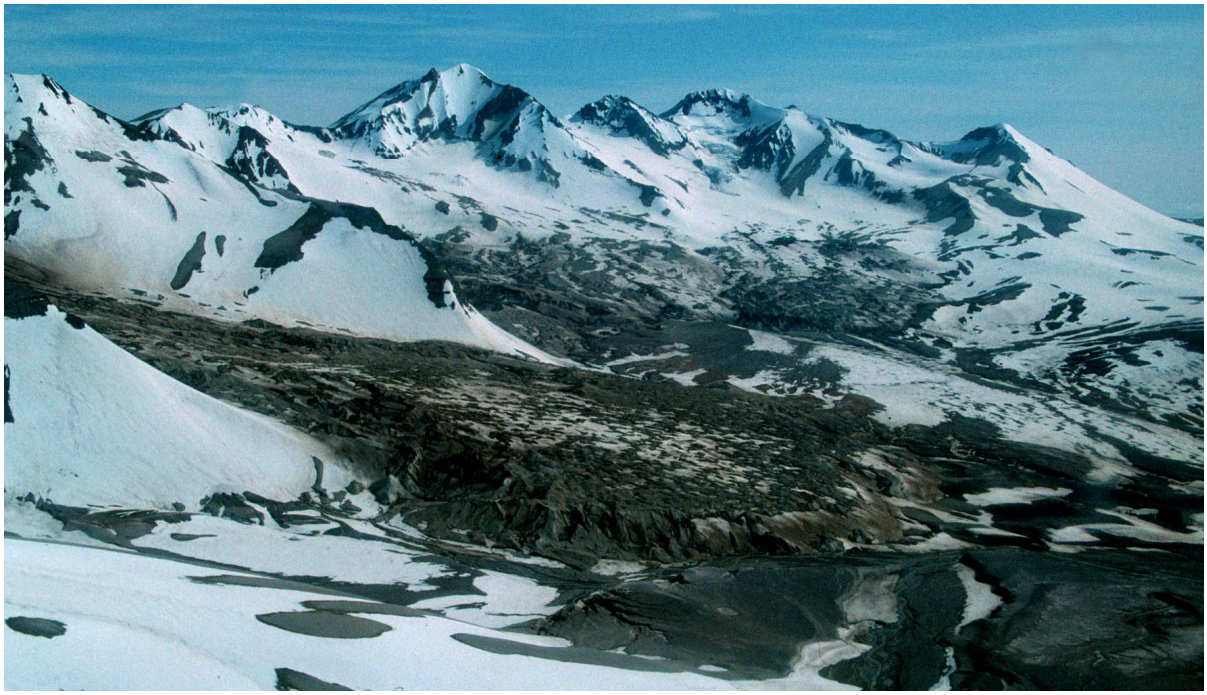
Geology and physiography: This is the moraine that surrounds Naknek Lake, it is of the age of the Iliamna advance (Pleistocene). It is composed of a series of small moraines with numerous kettles.

Elevation: 200-600 ft

Vegetation/land cover: Mat cushion and lichen heath dry tundra vegetation types dominate these moraine complex. Kenai birch 'forest' [10-15 ft tall] occurs in scattered stands, especially on the south facing sides of the moraines (Young and Racine 1976).

Notes: This ecological subsection contrasts sharply with the surrounding units. Although the plant communities within this subsection are most likely the same as BBL and LRD, their distribution and abundance vary within each. This unit is similar to KLM, but that unit has a significant area of ground moraine and other deposits, while IDD is primarily composed of end moraine.

KEM Kegulik Mountains



Ecoregion: Alaska Peninsula

Geology and physiography: This subsection is comprised of tuffs, flows, breccias, and other volcanic deposits of Holocene and Pleistocene age. Novarupta, the source of the 1912 eruption, and Mt Trident, the source of the 1953-60 lava flows, are both within this subsection. Numerous active glaciers also cover this subsection.

Elevation: 200-6,700 ft

Vegetation/land cover: Snow and ice dominate much of this subsection. Alpine tundra, heath, and closed canapy shrubland dominate the rest of the area.

Notes: The eruption of 1912 is regarded as the largest volcanic eruption of the twentieth century. As part of this eruption approximately 20 km^3 of air-fall tephra and 11-15 km^3 ash flow tuff is thought to have been deposited (Hildreth 1983). Parts of this unit were absolutely blanketed in ash, while those further from Novarupta were not as heavily impacted. This is the youngest of the mountainous subsections in Katmai.

KLM Kukaklek Lake Moraines

Ecoregion: Alaska Peninsula

Geology and physiography: This subsection is comprised of an array of end moraines and ground moraines that are Pleistocene-aged. Mixtures of other glacial deposits are also included.

Elevation: 800-1,400 ft

Vegetation/land cover: Low shrub tundra and lichen shrub tundra dominate the vegetation of this subsection (Wibbenmeyer et al. 1982).

Notes: Two different polygons occur, both with striking complexes of moraines as well as other associated surficial deposits. It is similar to IDD, while that unit is primarily end moraine. This unit has a significant area of ground moraine and other deposits.

KRF Katmai River Floodplain

Ecoregion: Alaska Peninsula

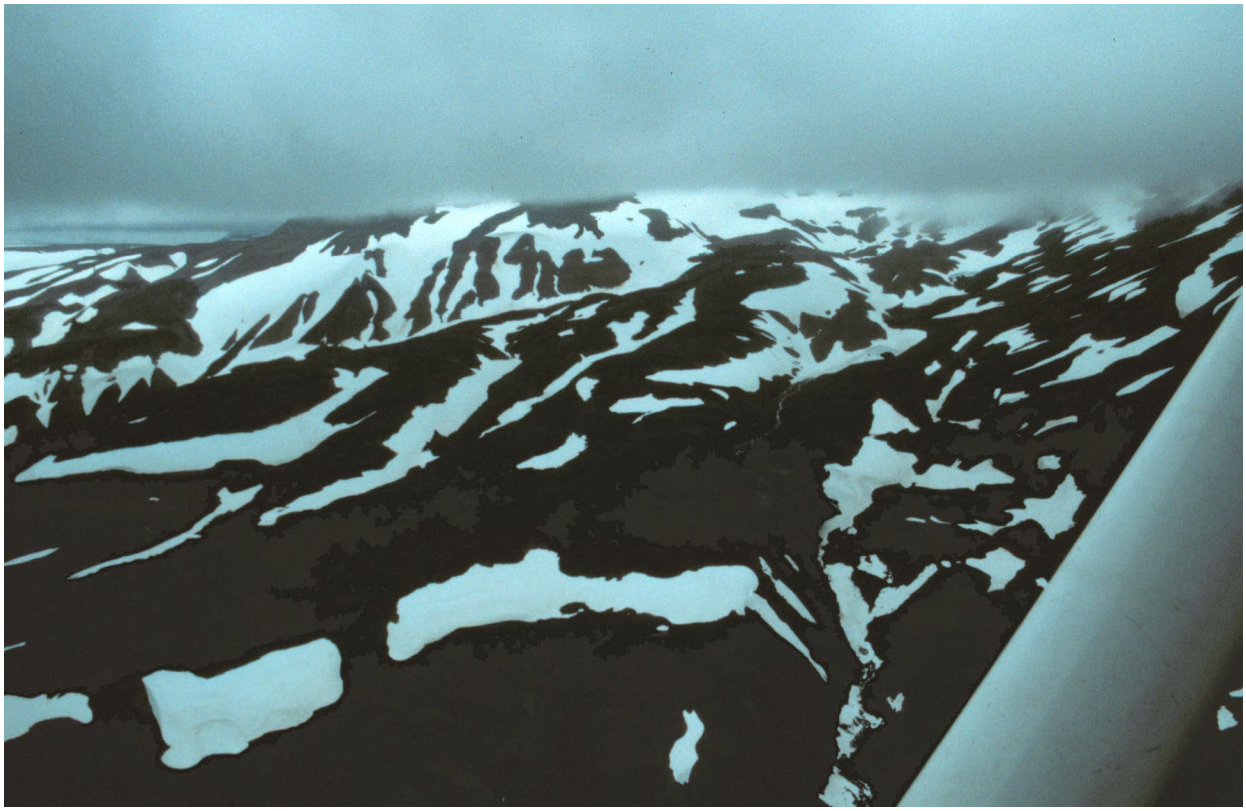
Geology and physiography: this subsection is the Katmai River Floodplain which has been choked with ash from the 1912 eruption. This is an aggrading alluvial system with lots of quicksand.

Elevation: 0-200ft

Vegetation/land cover: Between the extreme aggrading alluvial system and the wind blowing ash, few areas have been stable long enough for plants to get established.

Notes: This subsection is similar to TTS subsection, in that they are both comprised of ash from the 1912 eruption. They differ in that this subsection is completely alluvial process-driven, while TTS is not. Griggs (1922) described the aftermath of a flood event, which drained a temporary lake that had formed behind a large mudslide as a result of the eruption. This flood filled the entire floodplain with up to 10 feet of water. It may well be responsible for determining much of the character of this subsection, as it completely reworked and redeposited the ash, as well as destroying any residual vegetation.

KRH Kamishak River Hills



Ecoregion: Alaska Peninsula

KRH1 Kamishak River Hills -Highlands

No Photo

EcoSubsection: Kamishak River Hills

Geology and physiography: Low rolling hills and valleys scoured by ice during the Pleistocene. The low mountains within this subsection have been all overridden by icesheets during the Pleistocene. There are some poorly developed cirques along some of the highest ridges probably from more recent neoglaciation.

Elevation: 2,000-4,000 ft

Vegetation/land cover: This detailed subsection is comprised primarily of Fellfield alpine tundra.

Notes: Similar to WAM1 and SKM1 but these two units both had periods of alpine glaciation that has determined much of the physiography, while KRH1 has not.

KRH2 Kamishak River Hills –Valley Bottoms

No Photo

EcoSubsection: Kamishak River Hills

Geology and physiography: Low rolling hills and valleys scoured by ice during the Pleistocene. The low mountains within this subsection have been all overridden by icesheets during the Pleistocene.

Elevation: 0-2,000 ft

Vegetation/land cover: Alder covered sideslopes are one of the dominant plant communities within this detailed subsection.

Notes: Similar to WAM2 and SKM2 but these two units both had periods of alpine glaciation that has determined much of the physiography, while KRH2 has not.

LOD Lowland outwash and drift deposits

No Photo

Ecoregion: Alaska Peninsula

Geology and physiography: Undifferentiated outwash and drift with surface/groundwater flow features that seem to be determining vegetation and soil patterns

Elevation: 200-1,000 ft

Vegetation/land cover: Dry tundra (Mat and cushion; Lichen heath) and Moist tundra (Dwarf shrub; Tussock meadow) are some of the most common vegetation types within this subsection (Young and Racine 1976).

Notes: The King Salmon river flows through this subsection. This subsection is most similar to ARD.

LRD Lakes Region old lake bed deposits

Ecoregion: Alaska Peninsula

Geology and physiography: Pleistocene and Holocene lake deposits, primarily in intramoraine basins. A mix of fine-grained deposits and coarser-grained lake shore terraces.

Elevation: 35-200 ft

Vegetation/land cover: Open low shrub graminoid, graminoid shrub tundra, and open tall shrub are the dominate vegetation classes within this subsection.

Notes: Similar to CLD adjacent to Coville Lake. CLD is much more in the forested zone than LRD. LRD has many old lake shore terraces interspersed within the matrix of lacustrine deposits while CLD does not.

LRH Lakes Region Hills

Ecoregion: Alaska Peninsula

Geology and physiography: This subsection is composed of 10 polygons of rounded bedrock foothills of mixed lithology. These hills are partially till covered and have numerous solifluction lobes.

Elevation: 500-3,000 ft

Vegetation/land cover: Paper Birch and balsam poplar forests occur on some of the side slopes. Alder thickets (1-2m tall) with a Bluejoint-horsetail understory occur on some of the steeper slopes. Tall willow shrub thickets (mostly Barclay willow) occur on lower slopes. On the tops of these hills Crowberry tundra is common. (based on 142 plots -Smith 1998; Young and Racine 1976)

Notes: These low rounded hills have not been overridden by glaciers since the early Pleistocene. This subsection is somewhat similar to the lower foothills within SKM.

LRM Lakes Region Spruce covered Moraines

Eoregion: Alaska Peninsula

Geology and physiography: This subsection is composed of moraines, till, colluvial deposits, and small bedrock hills from Brooks to Nonvianuk Lakes.

Elevation: 50-1,000 ft

Vegetation/land cover: This subsection contains the furthest southwest stand of white spruce, although very open white spruce woodlands occurs a bit further west. This subsection and SRF have the largest stands of white spruce within the park. Open White spruce stands are common. Lowbush cranberry and crowberry are two of the dominants in the understory. Open White spruce-Paper Birch stands also common in this subsection. Either with an ericaceous understory or occasionally with a bluejoint grass understory. Open willow stands are also common in the wetter areas. Sedges are the common understory in the wetter areas while bluejoint grass is more common in the drier areas. Wet sedge meadow tundra occurs in the wetter areas in swales (Smith 1998 –120 plots).

Notes: Similar to IDD except that this subsection is primarily forested while that moraine subsection is not.

SKM South Kegulik Mountains

SKM1 South Kegulik Mountains -Ridges

Ecoregion: Alaska Peninsula

EcoSubsection: South Kegulik Mountains

Geology and physiography: Mixed lithology (volcanic and sedimentary) area that has been heavily glaciated during the Pleistocene (otherwise resemble Kegulik mtns subsection).

Elevation: 1,000-5,000 ft

Vegetation/land cover: This detailed subsection is comprised primarily of Fellfield alpine tundra. Crowberry and alpine azalea are common. It is similar to the lowland mat and cushion dry tundra except that Dryas is often more abundant, *Rhododendron camtschaticum* occurs, and overall species cover is lower and there is a corresponding increase in bare rock and soil (Smith 1998 –1 plot, Young and Racine 1976).

Notes: Similar to WAM1 and KRH1. SKM1 and WAM1 each had periods of alpine glaciation that has determined much of the physiography, while KRH1 has not. KEM is also similar, but of much more recent volcanic origin.

SKM2 South Kegulik Mountains -Valleys

No Photo

EcoSubsection: South Kegulik Mountains

Geology and physiography: Mixed lithology (volcanic and sedimentary) area that has been heavily glaciated during the Pleistocene (otherwise this area resembles Kegulik mtns subsection).

Elevation: 100-1,200 ft

Vegetation/land cover: Willow and alder stands are very common within a matrix of bluejoint grass community types. Beauverd spirea, fireweed and other forbs are scattered through the bluejoint grass. Crowberry dwarf shrub tundra community types are common on the drier sites (Smith 1998 –68 plots).

Notes: Similar to WAM1 and KRH1. SKM1 and WAM1 each had periods of alpine glaciation that has determined much of the physiography, while KRH1 has not. KEM is also similar, but of much more recent volcanic origin.

SRF **Savonski River Floodplain**

Ecoregion: Alaska Peninsula

Geology and physiography: Large active aggrading river system with white spruce forests. Overbank silt deposits dominated by various wetland community types. Part of the largest drainage basin in the park.Elevation: 50-700 ft

Vegetation/land cover: Young White Spruce stands have developed on well-drained surfaces. This subsection and SRF have the largest stands of white spruce within the park.

Notes: Two floodplain subsections occur in Katmai, this one and KRF. KRF is very different due to the incredible ash deposition in the drainage basin.

SSL Shelikof Strait Lowlands

Ecoregion: Alaska Peninsula

Geology and physiography: This subsection is composed of a complex of beach, estuarine, outwash and alluvial deposits. Associated with streams with high sediment loads-either of glacial origin or volcanic or both.

Elevation: 0-150 ft

Vegetation/land cover: This subsection is a complex of wetland community types such as sweetgale-bluejoint, stands of willow, and lyngbyei sedge (right near the coast). Black Cottonwood stands are common along alluvial and drier outwash surfaces. Scattered stands of sitka spruce also occur here (Smith 1998 –85 plots).

Notes: There are no subsections similar to this one. A long-term uplift along this segment of coast has been responsible for the development of the array of coastal landforms found here (Crowell and Mann 1996).

TTS Valley of Ten Thousand Smokes

Ecoregion: Alaska Peninsula

Geology and physiography: This subsection is composed of Pyroclastic flows and ash from the 1912 eruption. This is the only area where welded tuff (from very hot pyroclastic flows) was deposited, indeed one of the few historic eruptions to have produced welded tuff). Approximately 11 km^3 of ash-flow tuff were deposited in this valley during the eruption (Hildreth 1983).

Elevation: 500-2,600 ft

Vegetation/land cover: Early pioneer vegetation such as alder is still becoming established.

WAM Walatka Mountains

Ecoregion: Alaska Peninsula

WAM1 Walatka Mountains –Highlands

EcoSubsection: Walatka Mountains

Geology and physiography: Angular sedimentary and granitic mountains that are 3,000 to 5,000 feet. Neoglaciation has formed numerous cirques, eretes, and horns

Elevation: 1,500-5,000 ft

Vegetation/land cover: Crowberry dwarf shrub tundra (some of the dominant species include: crowberry, least willow, bog blueberry and dwarf arctic birch) and Mountain-heath dwarf shrub tundra (some of the dominant species include: alpine bearberry, Luetkea, and those species mentioned above) and variations on these themes are the most common community types (Smith 1998 –8 plots).

Notes: Similar to SKM1 and KRH1. SKM1 and WAM1 each had periods of alpine glaciation that has determined much of the physiography, while KRH1 has not. SKM is a mix of volcanic and sedimentary rocks, while WAM is a mix of granite and sedimentary rocks.

WAM2 Walatka Mountains –Valley Bottoms

No Photo

EcoSubsection: Walatka Mountains

Geology and physiography: This subsection is composed of angular sedimentary and granitic mountains. Neoglaciation has formed numerous cirques, eretes, and horns.

Elevation: 600-2,000 ft

Vegetation/land cover: Closed tall alder communities are common on the sideslopes. Red elderberry and devil's club are other shrubs scattered within these stands. Ladyfern and bluejoint grass are dominants within the understory. Open cottonwood stands and occasional wet sedge meadows both occur right in the bottom of the valleys (Smith 1998 –12 plots).

Notes: Similar to SKM and KRH. SKM and WAM each had periods of alpine glaciation that has determined much of the physiography, while KRH has not. SKM is a mix of volcanic and sedimentary rocks, while WAM is a mix of granite and sedimentary rocks.

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Figure 1. Map of Ecological Subsections for Katmai National Park & Preserve and Alagnak Wild River, Alaska