Alaska - Yukon Arctic Ecoregional Assessment
Update #3: Gap Analysis of Terrestrial Ecosystems

Introduction

A standard approach among organizations and agencies worldwide for maintaining natural biological diversity is to conserve an adequate representation of every kind of habitat, or ecosystem, in an ecoregion. In the Alaska-Yukon Arctic ecoregion, several areas are currently managed with an explicit emphasis on conservation, while others are not. This update uses methods established by the Gap Analysis Program[1] to quantify the level of protection of each type of terrestrial ecosystem[2] in the Alaska-Yukon Arctic. Three questions are examined in this update:

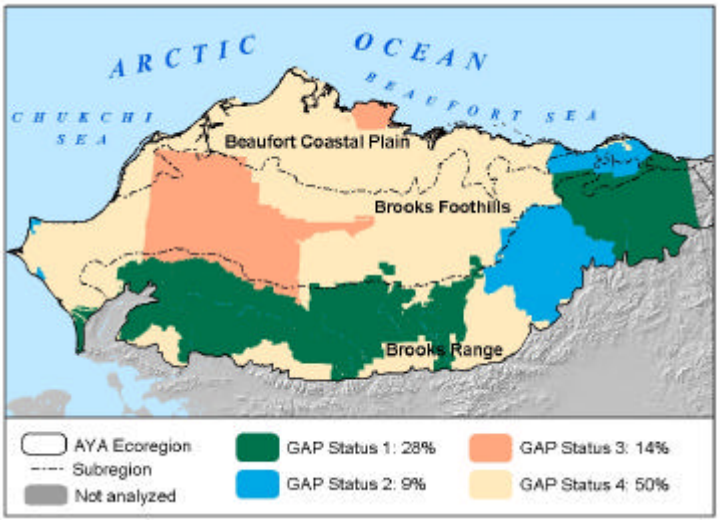
1. How much of the land in the ecoregion is explicitly managed for conservation?
2. To what extent are terrestrial systems represented in conservation areas across the ecoregion?
3. To what extent are terrestrial systems represented in conservation areas in each of the ecoregion's three subregions?

Implications of the results of the analyses are discussed at the end of this update.

Analysis 1: Gap Status Map

In the first analysis, we classified land management according to the degree to which the land is explicitly managed for conservation. Drawing from the Gap Program's methods and written management plans or general ownership intent, we assigned status ranks to lands in the Alaska portion of the Alaska-Yukon Arctic ecoregion (Figure 1, Table 1). Status 1 lands are managed with an emphasis on conservation, while status 4 lands have no mandated conservation management or are used primarily for human activity. Coarse-scale spatial datasets of land ownership and management were combined in a geographical information system (GIS)

Figure 1. GAP Status of Alaska Portion of Ecoregion



[1] The Gap (Gap Analysis Program) is run by the U.S. Geological Survey. Two primary goals of Gap are to provide an assessment of the management status for certain elements of biodiversity (vegetation communities and animal species) throughout their U.S. range, and to provide land stewards with information on the representation of these elements on their land so they can make informed decisions about their management practices regarding biodiversity. See References for web link to Gap Program and methods.

[2] Terrestrial ecosystems are groups of plant and animal communities that (1) occur together on the landscape due to similar ecological processes and underlying features; (2) form readily identifiable units that serve practical needs for mapping, stewardship, and monitoring. See Update #2 for more on the Predictive Terrestrial Ecosystem Model developed for the Alaska-Yukon Arctic ecoregion.

to create this data layer of land management within the ecoregion (see Input Data). In cases where information on land management conflicted, the lower Gap status was applied.

The results of the analysis suggest that approximately one-third (37%) of the ecoregion is managed for conservation to a greater degree (Gap status1 and 2), while two-thirds (64%) of the area is managed to a lesser degree or not at all for conservation (Gap status 3 and 4). Gap status 1 and 2 lands are considered to constitute the existing conservation network.

Table 1. Gap Status Ranks

Gap Status Rank	Descriptions (modified from Scott, 1993)	Land Categories in the Alaska portion of Alaska–Yukon Arctic Ecoregion
1	An area with an active management plan in operation that is maintained in its natural state and within which natural disturbance events are either allowed to proceed without interference or are mimicked through management.	• Areas of Critical Environmental Concern (ACEC): Outstanding Natural Areas (ONA), Research Natural Areas (RNA), or Natural Hazard Area (NHA) • U.S. National Park Service national monument, park, and preserve • U.S. Fish and Wildlife Service wilderness area
2	An area that is generally managed for its natural values, but which may receive use that degrades the quality of natural communities that are present.	• Federal wild and scenic rivers (regardless of agency) • U.S. Fish and Wildlife Service refuge (non-wilderness)
3	Most undesignated public lands; legal mandates prevent permanent conversion to anthropogenic habitat types and confer protection to populations of endangered species.	• U.S. Bureau of Land Management National Petroleum Reserve (includes special areas)
4	Private or public land without an existing conservation easement or management plan designed to maintain native species and communities, or which is managed primarily for human activity.	• Lands and waters available for lease • Native regional corporation lands • Private, state and native selected land • Private land • State of Alaska and BLM undesignated land • BLM utility corridor planning area • U.S. Department of Defense land

Analysis 2: Gap Analysis of Terrestrial Ecosystems

We applied a regional terrestrial ecosystem model developed by Jorgenson and Heiner (2003) to determine the extent to which terrestrial ecosystems are represented by the existing conservation network. We selected 30% representation as a minimum benchmark for this analysis, although it is an arbitrary cutoff point.[3] The results indicate that of the 35 terrestrial ecosystems within the ecoregion, fewer than half (14 of 35) have greater than 30% of their distribution within Gap status 1 and 2 lands (Table 2). The remaining 22 ecosystems are mostly (>70%) distributed on lands not managed for conservation. Of the three most abundant ecosystems – upland shrubby

[3] The 30% minimum benchmark is based on work by Dobson (1996) and MacArthur and Wilson (1967) that describes the expected rate of change in number of native species with a corresponding change in available habitat area. This relationship is expressed mathematically as a species-area curve. The curve suggests that by preserving 30% of the historical area of a particular system, 65% to 85% of the original native species might be expected to remain. Here we use 30% as a minimum, arbitrary cutoff point for analysis. It does not imply that we endorse 30% as a conservation goal in the Alaska-Yukon Arctic ecoregion.

tussock tundra, upland low shrub birch-willow tundra, and alpine noncarbonate dwarf shrub tundra, which comprise more than 50% of the ecoregion – two surpass the 30% representation benchmark, while one of them (upland shrubby tussock tundra) is only 20% represented in the conservation network (see highlights in Table 2).

Of the 14 terrestrial ecosystems that are underrepresented (<30%) in Gap status 1 and 2, eight contribute 1% or less to the total area of the ecoregion. It is unclear whether their limited distribution means that they are truly rare in the ecoregion, or whether they are artifacts of the terrestrial ecosystem model.

Table 2. Gap Status of Terrestrial Ecosystems in the Alaska-Yukon Arctic

Terrestrial Ecosystem	Total Area in Ecoregion (Ha)	Proportion of Ecoregion	GAP Status 1 and 2	GAP Status 3 and 4
Coastal Barrens	50,388	<<1%	**3%**	97%
Upland Tussock Tundra	1,714,375	6%	**3%**	97%
Coastal Grass and Dwarf Shrub Tundra	149,861	1%	**4%**	96%
Lowland Lake	1,045,669	3%	**6%**	94%
Coastal Wet Sedge Tundra	131,693	<<1%	**6%**	94%
Lowland Moist Sedge-Shrub Tundra	1,959,265	7%	**7%**	93%
Lowland Wet Sedge Tundra	1,587,780	5%	**10%**	90%
Coastal Water	154,170	1%	**11%**	89%
Riverine Wet Sedge Tundra	207,921	1%	**15%**	85%
Riverine Moist Sedge-Shrub Tundra	567,950	2%	**18%**	82%
Upland Shrubby Tussock Tundra	5,764,102	19%	**20%**	80%
Riverine Barrens	196,076	1%	**26%**	74%
Riverine Waters	150,881	1%	**26%**	74%
Riverine Willow Shrub Tundra	157,194	1%	**27%**	73%
Upland Low Shrub Birch-Willow Tundra	6,152,402	21%	**39%**	61%
Lowland Low Birch-Willow Shrub	319,433	1%	**39%**	61%
Upland Moist Sedge-Shrub Tundra	2,004,504	7%	**40%**	60%
Lowland Spruce Forest	177,388	1%	**41%**	59%
Upland Birch-Aspen-Spruce Forest	21,550	<<1%	**48%**	52%
Riverine Spruce-Balsam Poplar Forest	2,905	<<1%	**50%**	50%
Upland Spruce Forest	624,516	2%	**52%**	48%
Upland Birch-Aspen Forest	23,221	<<1%	**53%**	47%
Upland Dryas Dwarf Shrub Tundra	750,953	3%	**55%**	45%
Alpine Carbonate Barrens	128,025	<<1%	**55%**	45%
Riverine Spruce Forest	52,046	<<1%	**61%**	39%
Alpine Carbonate Dwarf Shrub Tundra	173,176	1%	**63%**	37%
Riverine Balsam Poplar Forest	2,943	<<1%	**64%**	36%
Upland Tall Alder Shrub	392,458	1%	**66%**	34%
Alpine Noncarbonate Dwarf Shrub Tundra	3,418,018	11%	**83%**	17%
Riverine Alder-Willow Shrub	10,897	0%	**83%**	17%
Alpine Noncarbonate Barrens	1,601,605	5%	**85%**	15%
Riverine Dryas Dwarf Shrub Tundra	62,969	<<1%	**89%**	11%
Alpine Glaciers	23,393	<<1%	**94%**	6%
Alpine Mafic Dwarf Shrub Tundra	47,801	<<1%	**97%**	3%
Alpine Mafic Barrens	56,770	<<1%	**99%**	1%
TOTALS	**29,884,298**	**100%**		

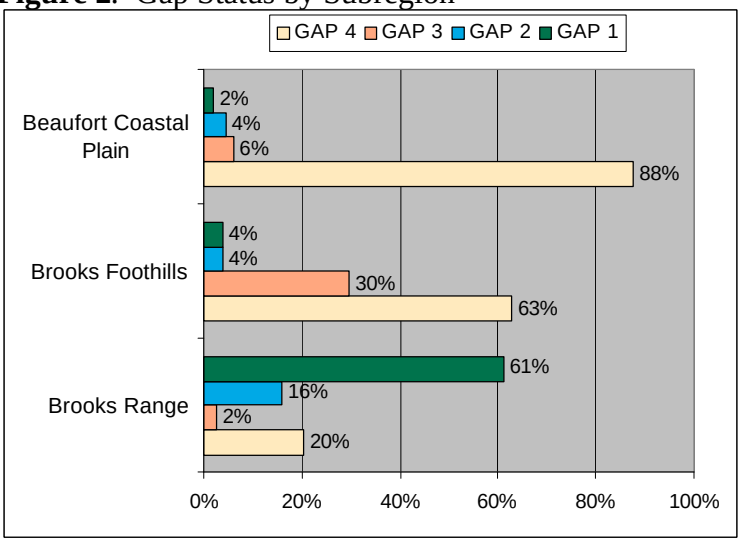
Analysis 3: Gap Analysis of Terrestrial Ecosystems by Subregion

The Alaska-Yukon Arctic ecoregion is composed of three distinct subregions – Beaufort Coastal Plain, Brooks Foothills, and Brooks Range (Nowacki et al 2001). Each differs greatly in its composition of terrestrial ecosystems, as well as in the degree to which they are represented in the conservation network. Analysis 3 examines representation by highlighting the most common, or abundant, terrestrial ecosystems in each subregion (see Tables 3-5).

Gap Status of Subregions

Conservation status is distributed unequally among the three subregions: only 6% of the Beaufort Coastal Plain and 8% of the Brooks Foothills are managed as Gap status 1 or 2 lands, while 77% of the Brooks Range subregion is included in the existing conservation network (Figure 2).

Figure 2. Gap Status by Subregion



Beaufort Coastal Plain

Only 3 of the Beaufort Coastal Plain's 18 terrestrial ecosystems currently meet the 30% benchmark for representation in the conservation network (Table 3), and these three systems constitute less than 4% of the total area of the coastal plain. The 4 most abundant ecosystems, on the other hand, make up 77% of the area (see highlights in Table 3), but each is represented less than 10% among Gap status 1 and 2 lands.

Table 3. Gap Status of Terrestrial Ecosystems within the Beaufort Coastal Plain Subregion

Terrestrial Ecosystems	Area in Ecoregion (Ha)	Proportion of Ecoregion	Gap Status 1 and 2	Gap Status 3 and 4
Upland Dryas Dwarf Shrub Tundra	95,870	2%	**1%**	99%
Lowland Lake	911,979	15%	**1%**	99%
Coastal Barrens	48,167	1%	**2%**	98%
Upland Tussock Tundra	789,385	13%	**3%**	97%
Coastal Grass and Dwarf Shrub Tundra	133,372	2%	**4%**	96%
Riverine Moist Sedge-Shrub Tundra	235,476	4%	**4%**	96%
Lowland Moist Sedge-Shrub Tundra	1,614,688	27%	**6%**	94%
Coastal Wet Sedge Tundra	127,621	2%	**6%**	94%
Lowland Wet Sedge Tundra	1,300,366	22%	**8%**	92%
Riverine Willow Shrub Tundra	17,068	<<1%	**8%**	92%
Coastal Water	136,579	2%	**8%**	92%
Riverine Barrens	82,068	1%	**12%**	88%
Riverine Wet Sedge Tundra	141,712	2%	**12%**	88%
Riverine Waters	84,657	1%	**15%**	85%
Upland Low Shrub Birch-Willow Tundra	435	<<1%	**27%**	73%
Lowland Low Birch-Willow Shrub	122,609	2%	**30%**	70%
Upland Moist Sedge-Shrub Tundra	35,549	1%	**42%**	58%
Upland Shrubby Tussock Tundra	16,859	<<1%	**48%**	52%
TOTALS	**5,894,460**	**100%**		

Brooks Foothills

In the Brooks Foothills, one-fifth of the terrestrial ecosystems are sufficiently represented (>30%) in Gap status 1 and 2 lands. Yet these systems constitute less than 5% of the entire Brooks Foothills subregion. The majority of the subregion (87%) is composed of just four terrestrial system types, but none of these four meet the 30% benchmark in the conservation network. In fact, each of the four most abundant systems has 15% or less of its area in Gap status 1 and 2 lands (highlighted in Table 4).

Table 4. Gap Status of Terrestrial Ecosystems within the Brooks Foothills Subregion

Terrestrial Ecosystems	Area in Ecoregion (Ha)	Proportion of Ecoregion	Gap Status 1 and 2	Gap Status 3 and 4
Upland Tussock Tundra	924,951	8%	**3%**	97%
Riverine Moist Sedge-Shrub Tundra	234,036	2%	**4%**	96%
Riverine Willow Shrub Tundra	99,412	1%	**4%**	96%
Alpine Mafic Dwarf Shrub Tundra	852	<<1%	**5%**	95%
Coastal Grass and Dwarf Shrub Tundra	16,489	<<1%	**5%**	95%
Upland Low Shrub Birch-Willow Tundra	3,270,852	28%	**6%**	94%
Upland Shrubby Tussock Tundra	4,679,946	41%	**7%**	93%
Lowland Low Birch-Willow Shrub	94,864	1%	**8%**	92%
Coastal Wet Sedge Tundra	4,072	<<1%	**8%**	92%
Lowland Moist Sedge-Shrub Tundra	344,493	3%	**9%**	91%
Lowland Lake	69,499	1%	**10%**	90%
Riverine Wet Sedge Tundra	55,920	<<1%	**12%**	88%
Riverine Barrens	76,574	1%	**12%**	88%
Coastal Barrens	2,221	<<1%	**12%**	88%
Riverine Waters	36,301	<<1%	**13%**	87%
Upland Moist Sedge-Shrub Tundra	1,169,965	10%	**15%**	85%
Lowland Wet Sedge Tundra	247,024	2%	**17%**	83%
Upland Dryas Dwarf Shrub Tundra	114,186	1%	**19%**	81%
Alpine Mafic Barrens	32,301	<<1%	**23%**	77%
Riverine Dryas Dwarf Shrub Tundra	566	<<1%	**28%**	72%
Coastal Water	17,591	<<1%	**34%**	66%
Upland Tall Alder Shrub	7,555	<<1%	**57%**	43%
Alpine Noncarbonate Barrens	478	<<1%	**60%**	40%
Alpine Carbonate Barrens	819	<<1%	**90%**	10%
Alpine Carbonate Dwarf Shrub Tundra	11	<<1%	**100%**	0%
TOTALS	**11,500,978**	**100%**		

Brooks Range

In contrast to the coastal plain and foothills subregions, all 31 terrestrial ecosystems in the Brooks Range meet the 30% representation benchmark in Gap status 1 and 2 lands. The three most abundant ecosystems make up 63% of the ecoregion and are very well represented (>75%) in GAP status 1 and 2 lands (see highlights in Table 5).

Table 5. Gap Status of Terrestrial Ecosystems within the Brooks Range Subregion

Terrestrial Ecosystems	Area in Ecoregion (Ha)	Proportion of Ecoregion	GAP Status 1 and 2	GAP Status 3 and 4
Lowland Spruce Forest	177,388	1%	**41%**	59%
Upland Birch-Aspen-Spruce Forest	21,550	<<1%	**48%**	52%
Riverine Spruce-Balsam Poplar Forest	2,905	<<1%	**50%**	50%
Upland Spruce Forest	624,516	5%	**52%**	48%
Upland Birch-Aspen Forest	23,221	<<1%	**53%**	47%
Alpine Carbonate Barrens	127,206	1%	**55%**	45%
Lowland Wet Sedge Tundra	40,390	<<1%	**60%**	40%
Riverine Spruce Forest	52,046	<<1%	**61%**	39%
Alpine Carbonate Dwarf Shrub Tundra	173,165	1%	**63%**	37%
Riverine Balsam Poplar Forest	2,943	<<1%	**64%**	36%
Upland Tall Alder Shrub	384,903	3%	**67%**	33%
Lowland Lake	64,191	1%	**68%**	32%
Upland Dryas Dwarf Shrub Tundra	540,897	4%	**72%**	28%
Riverine Waters	29,923	<<1%	**73%**	27%
Upland Low Shrub Birch-Willow Tundra	2,881,115	23%	**76%**	24%
Upland Moist Sedge-Shrub Tundra	798,990	6%	**77%**	23%
Upland Shrubby Tussock Tundra	1,067,297	9%	**78%**	22%
Lowland Low Birch-Willow Shrub	101,960	1%	**79%**	21%
Riverine Wet Sedge Tundra	10,289	<<1%	**80%**	20%
Riverine Alder-Willow Shrub	10,897	<<1%	**83%**	17%
Alpine Noncarbonate Dwarf Shrub Tundra	3,385,717	27%	**84%**	16%
Alpine Noncarbonate Barrens	1,601,127	13%	**85%**	15%
Riverine Moist Sedge-Shrub Tundra	98,438	1%	**85%**	15%
Riverine Barrens	37,434	<<1%	**85%**	15%
Riverine Dryas Dwarf Shrub Tundra	62,403	<<1%	**89%**	11%
Riverine Willow Shrub Tundra	40,714	<<1%	**91%**	9%
Alpine Glaciers	23,393	<<1%	**94%**	6%
Alpine Mafic Barrens	56,770	<<1%	**99%**	1%
Alpine Mafic Dwarf Shrub Tundra	46,949	<<1%	**99%**	1%
Lowland Moist Sedge-Shrub Tundra	84	<<1%	**100%**	0%
Upland Tussock Tundra	39	<<1%	**100%**	0%
TOTALS	**12,488,860**	**100%**		

Implications for Conservation

The conservation network in the Alaska-Yukon Arctic represents a greater number of habitats in the Brooks Range than in the foothills or coastal plain. In fact, the most abundant, character-defining terrestrial ecosystems of the foothills and coastal plain are only minimally represented in the conservation network (15% or less). Implications for long-term conservation of species that depend on the various habitats in these subregions could be significant. A vegetation map recently published by the University of Alaska Fairbanks (CAVM Team 2003) shows that 30% of all wetlands in the circumpolar arctic occur in Alaska, with a significant portion in the arctic coastal plain. Future updates on the Alaska-Yukon Arctic ecoregional assessment will show that the coastal plain supports a high species richness of birds and mammals. Together, these studies suggest that conservation of habitats and associated species in the coastal plain of arctic Alaska has global significance for maintaining natural biological diversity.

Contacts

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Previous Updates on the Alaska-Yukon Arctic Ecoregional Assessment

Update #1: Project Description
Update #2: Predictive Terrestrial Ecosystem Model

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The Nature Conservancy

The Nature Conservancy is an international non-profit conservation organization that seeks to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Ecoregional assessments employ a science-based approach to evaluate the biodiversity significance of landscapes. For the Alaska-Yukon Arctic, our goal is to gather sufficient information to identify areas of biological significance, evaluate current and potential stresses to biodiversity, and develop appropriate and constructive conservation strategies to ameliorate threats in special areas.