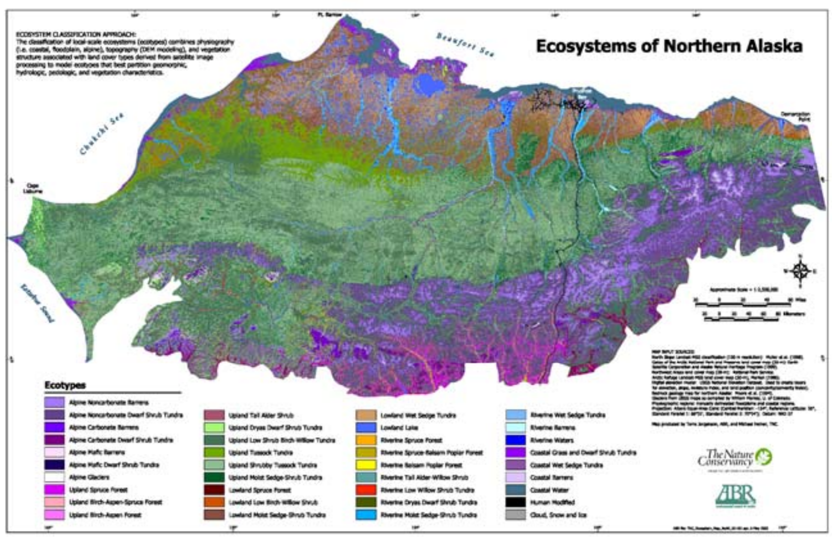
Alaska - Yukon Arctic Ecoregional Assessment
Update #2: Predictive Terrestrial Ecosystem Model

Predictive Terrestrial Ecosystems Model

This update describes a predictive terrestrial ecosystems model recently developed by The Nature Conservancy for the Alaska-Yukon Arctic ecoregion, a landscape covering approximately 117,000 mi^2 in Alaska from the Brooks Range to the North Slope. Future versions of the model will encompass the additional 12,500 mi^2 of the ecoregion in Canada.

The model was developed to provide a seamless ecological context for analysis of the distribution of biodiversity in the ecoregion. Existing land cover maps covering portions of the project area were compiled, integrated and reclassified using ancillary information to partition ecological characteristics. Physical, biological and geographical information were incorporated to produce a comprehensive map of 36 terrestrial ecosystem classes. The model covers a large area; therefore, the map is coarse scale, and it has not been verified by on-the-ground inventory. The model and ecosystem descriptions are available upon request.

Terrestrial ecosystems are groups of plant and animal communities that occur together on the landscape due to similar ecological process, (e.g., fire or hydrology), and landscape characteristics (e.g., elevation). Predictive mapping of terrestrial ecosystems uses available spatial data and knowledge of ecological and landscape relationships to develop 'rules' for mapping the landscape.



Purposes of the Model

The model will be used to describe the ecological backdrop of the Alaska-Yukon Arctic ecoregion. It will also be used as a filter in a representation analysis to determine which ecosystem classes are, and are not, currently represented in the existing conservation network in the ecoregion.

In addition, the thirty-six ecosystem classes represented by the model will be used as coarse-scale surrogates to represent finer-scale elements of biodiversity about which we have little or no information. This helps meet a goal of the ecoregional assessment: to identify areas that, if managed with an emphasis on biodiversity, would likely conserve the ecoregion's species and habitats over the long-term. Because we have incomplete knowledge of the distribution of all species and habitats, the terrestrial systems can act as a representative surrogates.

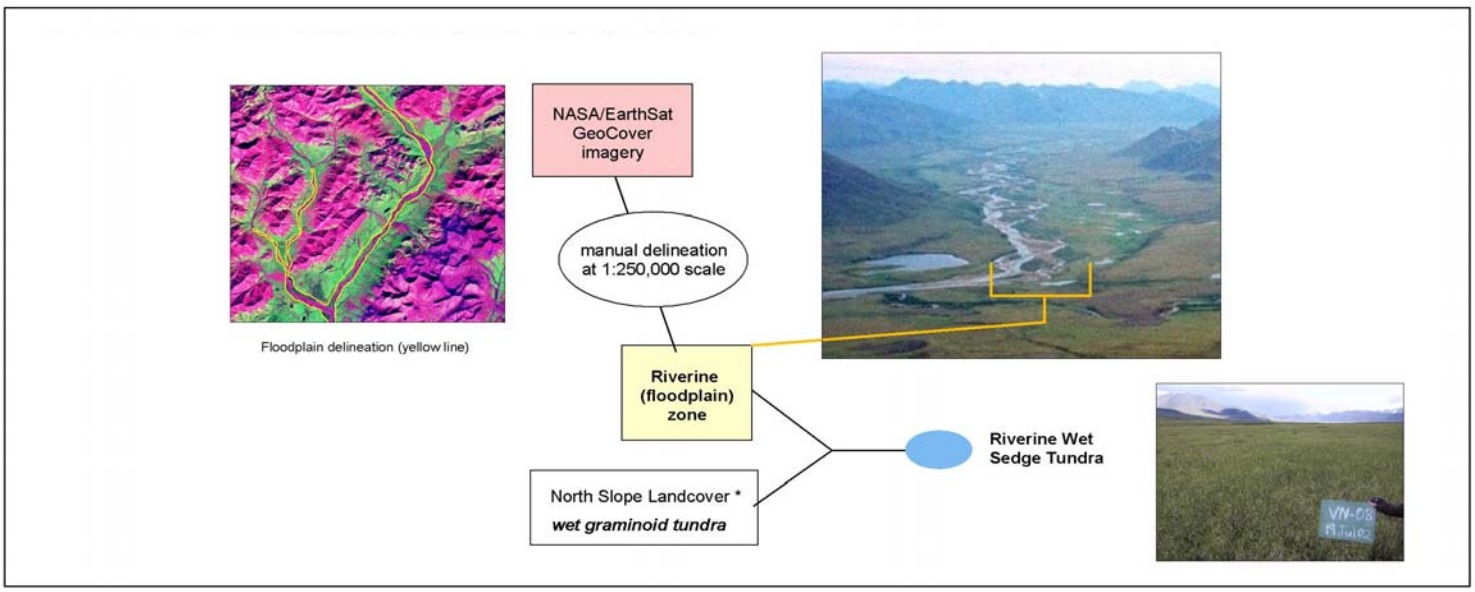
Components of the Model

The terrestrial ecosystem model integrates physiography (coastal, floodplain, and alpine zones), topography, vegetation structure, and bedrock geology to produce a bio-physical classification that best partitions geomorphic, hydrologic, pedologic, and vegetation characteristics. The primary components of the model are described below.

Physiography: Floodplains and Coastal Areas

Floodplains and coastal areas are of special importance to the ecology of the ecoregion. In terms of physical processes, floristics, and productivity, floodplains and coastal areas are distinct features but difficult to map via remote sensing or automated methods. Thus, floodplain and salt-affected areas were manually-delineated using Landsat 5 TM imagery as a guide (Figure 1).

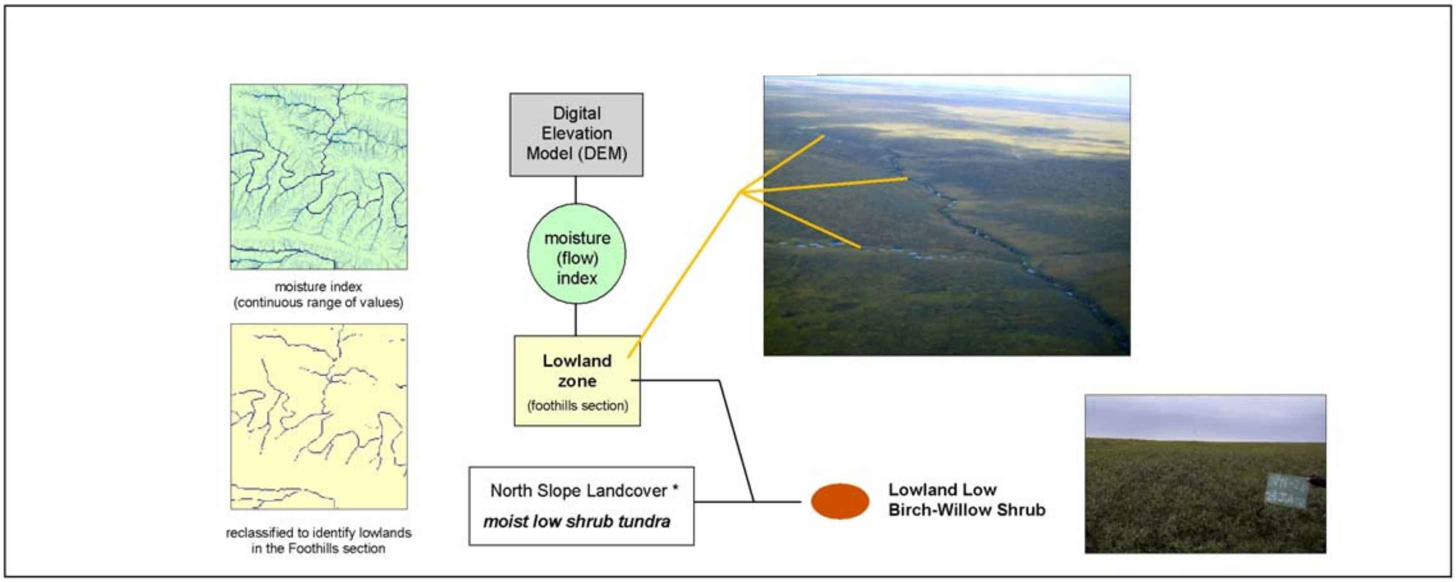
Figure 1. Use of manual delineation to identify major floodplains.



Topographic Indices

To account for key physical characteristics of the landscape, several GIS layers were created from a digital elevation model (DEM; USGS NED, 42 m cell size). These layers include a moisture index, which was used to describe lowlands in the foothills region of the project area (Figure 2); a topographic position index, to predict the distribution of tussock tundra on the coastal plain; and elevation, to identify the alpine vegetation zone.

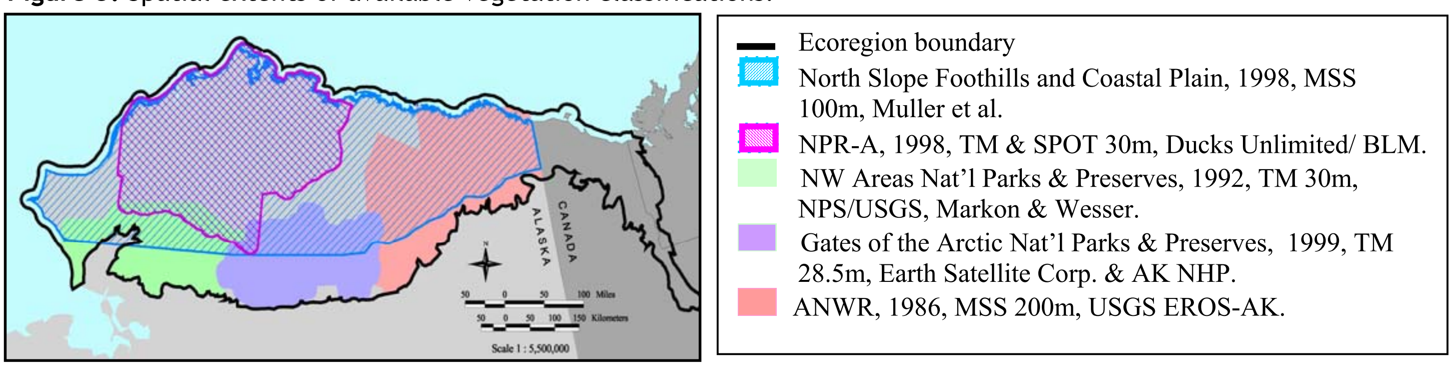
Figure 2. Use of topographic indices to identify lowlands in the foothills region.



Vegetation Structure

Landcover maps of portions of northern Alaska (Muller et al. 1998, National Park Service 1999, National Park Service date unknown, Markon 1986) were re-interpreted and combined into a map of consistent thematic classification and spatial resolution to generate a seamless, unified map of terrestrial ecosystems for the project area. These data were used to represent physiognomy, or vegetation structure, across the ecoregion. The extent of landcover maps is shown in Figure 3.

Figure 3. Spatial extents of available vegetation classifications.



Bedrock Geology

A map of bedrock geology for Northern Alaska (Moore et al. 1994) was re-classified as carbonate, noncarbonate, or mafic parent material, to describe substrate chemistry of exposed bedrock.

Summary of Model Results

Table 1 summarizes the abundance and distribution of the 36 ecosystem types predicted by the model in the three terrestrial subregions that comprise the Alaska portion of the project area, the Beaufort Coastal Plain, the Brooks Foothills, and the Brooks Range (Nowacki et al. 2001).

Table 1. Summary of model results.

Ecosystem Classes	**Coastal Plain** (%)	**Foothills** (%)	**Brooks Range** (%)	**Total** (%)
Alpine glaciers	0	0	0.2	0.1
Alpine noncarbonate barrens	0	<0.1	12.7	5.2
Alpine carbonate barrens	0	<0.1	1.0	0.4
Alpine mafic barrens	0	0	0.4	0.2
Alpine noncarbonate dwarf shrub tundra	0	0.3	26.8	11.2
Alpine carbonate dwarf shrub tundra	0	0	1.4	0.6
Alpine mafic dwarf shrub tundra	0	<0.1	0.4	0.2
Alpine types = 17.9% of ecoregion				
Upland spruce forest	0	0	4.9	2.0
Upland birch-aspen-spruce forest	0	0	0.2	0.1
Upland birch-aspen forest	0	0	0.2	0.1
Upland tall alder shrub	0	0.1	3.0	1.3
Upland low birch-willow shrub tundra	<0.1	28.3	22.8	20.1
Upland dryas dwarf shrub tundra	1.5	1.0	4.3	2.5
Upland shrubby tussock tundra	0.3	40.6	8.5	18.8
Upland tussock tundra	12.2	8.0	<0.1	5.6
Upland moist sedge-shrub tundra	0.5	10.1	6.3	6.5
Upland types = 57.0% of ecoregion				
Lowland spruce forest	0	0	1.4	0.6
Lowland low birch-willow shrub	1.9	0.8	0.8	1.0
Lowland moist sedge-shrub tundra	25.0	3.0	<0.1	6.4
Lowland wet sedge tundra	20.1	2.1	0.3	5.2
Lowland lake	14.1	0.6	0.5	3.4
Lowland types = 16.6% of ecoregion				
Riverine spruce forest	0	0	0.4	0.2
Riverine spruce-balsam poplar forest	0	0	<0.1	<0.1
Riverine balsam poplar forest	0	0	<0.1	<0.1
Riverine tall alder-willow shrub	0	0	0.1	<0.1
Riverine low willow shrub tundra	0.3	0.9	0.3	0.5
Riverine dryas dwarf shrub tundra	0	<0.1	0.5	0.2
Riverine moist sedge-shrub tundra	3.7	2.0	0.8	1.9
Riverine wet sedge tundra	2.2	0.5	0.1	0.7
Riverine barrens	1.3	0.7	0.3	0.6
Riverine waters	1.4	0.3	0.2	0.5
Riverine types = 4.6% of ecoregion				
Coastal grass and dwarf shrub tundra	2.1	0.2	0	0.5
Coastal wet sedge tundra	2.0	<0.1	0	0.4

Coastal barrens	0.8	<0.1	0	0.2
Coastal water	10.8	0.3	0	2.4
Coastal types = 3.5% of ecoregion				
Undetermined	<0.1	0.2	1.1	0.5
TOTAL = 100.1%				

Contacts

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Acknowledgements

The Nature Conservancy would like to acknowledge the significant contribution by ABR, Inc. toward the development and completion of the terrestrial ecosystem model. We would also like to recognize the financial support of the Bureau of Land Management for this project.

This work may be cited as: M. T. Jorgenson and M. Heiner. 2003. Ecosystems of Northern Alaska. Unpublished 1:2.5 million-scale map produced by ABR, Inc., Fairbanks, AK and The Nature Conservancy, Anchorage, AK.

Input Data

North Slope Landsat-MSS Classification, 1998, S.V. Muller, A.E. Racoviteanu, and D.A. Walker. 100m pixel resolution.

Nowacki, G., P. Spencer, T. Brock, M. Fleming, and T. Jorgenson. 2001. Ecoregions of Alaska and neighboring territory (map). U.S. Geological Survey, Reston, VA. http://agdc.usgs.gov/data/projects/fhm/akecoregions.jpeg

Land Cover Map of Gates of the Arctic National Park and Preserve, 1999, NPS, Alaska Support Office. 30m pixel resolution.

Moore, T.E., Wallace, W.K., Bird, K.J., Karl, S.M., Mull, C.G., and Dillon, J.T. 1994: Geology of northern Alaska, *in* Plafker, George, and Berg, H.C., eds., The geology of Alaska: Geological Society of America, The Geology of North America, v. G-1, p. 49-140.

Northwest Areas Landcover Map, pub. Date unknown, NPS, Alaska Support Office. 28.5m pixel resolution.

Arctic Refuge Landsat-MSS Landcover Map, 1986, USGS, EROS Alaska Field Office (Markon). 50m pixel resolution.

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.