Denali Biosphere Region

Periodic Review Report



Denali National Park and Preserve
National Park Service
Department of the Interior



ON THE COVER

Denalee (Denali), the High One, looms majestically before the Park Road.
NPS/Tim Rains

ON THIS PAGE

Each year, hundreds of thousands of visitors access the BR Core via the single Park Road. Some are lucky enough to have these stunning views of the mountain for which the Biosphere Region is named: Denali.
NPS/Jacob W. Frank

Denali Biosphere Region

Periodic Review Report



Authors

David Schirokauer

Dr. Rose Keller

National Park Service
Denali National Park and Preserve
PO Box 9
Denali National Park, AK 99755

September 2016

United States Department of the Interior

NATIONAL PARK SERVICE
Denali National Park & Preserve
Mile 237 Parks Highway
P.O. Box 9
Denali Park, AK 99755

10A (DENA)

September 14, 2016

U.S. Department of State
Office of UNESCO Affairs
2121 Virginia Avenue NW, Suite 6200
Washington DC, 20037

To the Bureau of the Man and Biosphere International Coordinating Council:

I am pleased to submit our response to the 2013 Periodic Review received from the United Nationals Education, Scientific, and Cultural Organization (UNESCO) Man and the Biosphere (MAB) program.

I appreciate how this program clearly connects sustainable development, and its benefit to local residents, to long term biodiversity conservation. Our participation in the MAB program has enhanced our ability to work cooperatively with the National Park Service's local, national, and international partners in, cooperative research, and management of resources. MAB has been foundational in our success in supporting cooperative environmental stewardship, wildlife monitoring, and the preservation of human traditions and subsistence livelihoods.

Going forward, the MAB program will allow us to leverage our international recognition to continue building relationships with circumpolar protected areas. We plan to engage with an international network of protected areas connected together via the natural cycles of climate and migrations.

Biosphere Regions, especially in the Arctic, allow a chance for wildlife, plants, and humans to adapt to the rapidly changing landscapes and ecosystems. In this era of dramatic global change, we need more people and institutions on the path towards a sustainable future in biodiversity conservation. To lose a biosphere is to lose momentum in conservation at a time when it is paramount for countless species and landscapes. I appreciate the leadership of the U.S. State Department in reinvigorating this program and am hopeful that the review of this document by UNESCO's MAB program proves successful.

Sincerely,

Don Striker
Superintendent

United Nations Educational, Scientific and Cultural Organization

Man and the Biosphere Programme

PERIODIC REVIEW
FOR BIOSPHERE RESERVE

INTRODUCTION

The UNESCO General Conference, at its 28th session, adopted Resolution 28 C/2.4 on the Statutory Framework of the World Network of Biosphere Reserves. This text defines in particular the criteria for an area to be qualified for designation as a biosphere reserve (Article 4). In addition, Article 9 foresees a periodic review every ten years, based on a report prepared by the concerned authority, on the basis of the criteria of Article 4 and forwarded to the secretariat by the State concerned. The text of the Statutory Framework is given in the third annex.

The form which follows is provided to help States to prepare their national reports in accordance with Article 9 and to update the data available to the Secretariat on the biosphere reserve concerned. This report should enable the International Coordinating Council (ICC) of the MAB Programme to review how each biosphere reserve is fulfilling the criteria of Article 4 of the Statutory Framework and in particular the three functions. It should be noted that it is requested, in the last part of the form (Criteria and Progress Made), to indicate how the biosphere reserve fulfills each of these criteria.

The information presented on this periodic review will be used in a number of ways by UNESCO:

(a) for examination of the biosphere reserve by the International Advisory Committee for Biosphere Reserves and by the Bureau of the MAB International Coordinating Council;

(b) for use in a world-wide accessible information system, notably for the UNESCO-MABnet and publications, facilitating communication and interaction amongst persons interested in biosphere reserves throughout the world.

Kindly indicate if any part of this report should remain confidential.

The form consists of three parts:

- Part one is a summary highlighting the main changes in the biosphere reserve during the reporting period.

- Part two is more descriptive and detailed, referring to the human, physical and biological characteristics as well as to the institutional aspects.

- Part three consists of two Annexes (A): the first Annex (A.1) will be used to update the directory of biosphere reserves on the MABnet. The second annex will be used to provide promotion and communication materials of the biosphere reserve (A.2).

The third annex comprises the Statutory Framework for the World Network of Biosphere Reserves.

Please provide as many quantitative data as possible as well as supporting documentation to complete the information provided, especially:

- Map(s) clearly showing the zonation (see in particular 2.3.1);

- The legal texts for the different zones.

The form should be completed in English, French or Spanish. Two copies should be sent to the Secretariat, as follows:

1. The original hard copy, with the original signatures, letters of endorsement, zonation map and supporting documents. This should be sent to the Secretariat through the Official UNESCO channels, i.e. via the National Commission for UNESCO and/or the Permanent Delegation to UNESCO.

2. An electronic version (on diskette, CD, etc.) of the periodic review form and of maps (especially the zonation map). This can be sent directly to the MAB Secretariat:

   UNESCO
   Division of Ecological and Earth Sciences
   1, rue Miollis F-75732 Paris Cedex 15, France. Tel: +33 (0)1 45 68 40 67
   Fax: +33 (0)1 45 68 58 04 E-mail: mab@unesco.org ; unesco.org/mab

Acknowledgments

The review process of the biosphere region program at Denali National Park has been an intensive but extraordinarily positive experience: reconnecting people with, and within Denali, reinvigorating our partnerships and commitments to international cooperation in preservation, science, and compassion for our planet and humankind.

It is with deep appreciation that we acknowledge the following individuals and groups who have both helped in our efforts to find a way forward and made significant contributions to our efforts:

Members of the Secretariat, the Bureau and the ICC;

Supporters of the Estes Park Workshop, especially Melinda Merrill

Colleagues of the U.S. State Department, especially Paul T. Mungai;

Members of the U.S. National Park Service especially Sarah Stehn, Carl Roland, Carol McIntyre, Laura Philips, Sierra McLane, Phoebe Gilbert, Erik Johnson, Kim Arthur, Amy Craver, Britta Schroeder, Shawn Burton and Andrew Gergte;

Denali National Park and Preserve partners: especially the Denali Borough and Mayor Clay Walker; and the Usebelli Coal Mine, Richard Silvis;

And a very special thanks to the following colleagues for their review: Stan Boychuk, Meriem Bouamrane, Natarajan Ishwaran, Johanna MacTaggart, and Andy Bell.

Table of Content

Page

INTRODUCTION iv

Acknowledgments vi

PART I. EXECUTIVE SUMMARY 1

PART II. PERIODIC REVIEW REPORT 11

Section 1. Introduction 11

Section 2. Significant Changes in the Biosphere Region, 1976-2016 12

Section 3. Ecosystem Services 37

Section 4. The Conservation Function 45

Section 5. The Development Function 53

Section 6. The Logistic Function 62

Section 7. Governance, Biosphere Region Management, and Coordination 71

Section 8. Criteria and Progress Made 82

Section 9. Supporting Documents 86

Section 10. Addresses 88

Figures

Page

Figure ES1. A map of the National Park Service Inventory and Monitoring Networks. 5
Figure 2.2.2. A map of Denali Biosphere Region Zone Overview. 14
Figure 2.2.3. A map of Denali Biosphere Region Inner Zones and Features. 15
Figure 2.3.2. Detail of budget expense categories. 27
Figure 2.3.8 Denali Biosphere Reserve Athabascan Languages 31
Figure 3.1 Denali Biosphere Region Land Cover. 38
Figure 5.2 Tourism Trends in Denali BR. Number of individuals by year shown by activity: shuttle bus visitors in tens of thousands (left axis) and other recreation visitors in thousands (right axis) Source: Denali NPS Social Science Public Use Statistics Database 57
Figure 6.1. Number of research permits issued per year by recipient. 63
Figure 7.1. Denali Biosphere Region Areas of Partnership and Cooperation in Governance. 73
Figure 7.2. Denali Biosphere Region Governance Structure. 74
Figure 7.3. Adaptive management cycle of assessment. 75

Tables

Page

Table 2.3.1. Resource Stewardship Strategy for Denali Park and Biosphere Region. 19
Table 2.3.2. Annual Activity and Expense Report Denali Biosphere/Park and Preserve 27
Table 4.2. Ongoing cultural resource Inventories. 48



NPS/TIM RAINS

View from Eielson Visitor Center along mile 66 of the Denali Park Road, looking south toward the Thorofare River and glacial bar.

PART I. EXECUTIVE SUMMARY

(a) Name of the biosphere reserve: Denali

(b) Country: USA

(c) Year of designation: 1976

(d) Year(s) of periodic review(s): First submission 2013; this is a resubmission in 2016

(e) Previous recommendation(s) made by the Man and the Biosphere International Coordinating Council (MAB-ICC), if applicable:

1. An updated periodic review report using the official periodic review form.

2. A zonation map showing a clearly defined core zone, managed use area, and transition zone.

3. Sustainable Development around biosphere reflecting the integration of sustainable development/human access zones in the Denali Biosphere.

(f) What follow-up actions are completed and if not completed/initiated, please provide justifications.

This is one of many US periodic review "re-submissions." To address the general issues associated with U.S. conformance to the United Nations Educational, Scientific and Cultural Organization (UNESCO) MAB policies, we have completed trips to the UNESCO MAB Rocky Mountain National Park co-sponsored workshop (September 2016); a trip to engage the Regional Alaska National Park Park's managers to determine a way forward to refine and redefine the Denali National Park and Preserve Management Strategy to conform to the UNESCO MAB programmatic. Specifically, Denali National Park and Preserve is committed to working on behalf of the larger landscape of the Denali Biosphere Region by promoting and facilitating meaningful engagement with the communities, industries, resource managers, tribal councils, and government entities tasked with managing the 18,032,602 hectare Denali Biosphere Region. Furthermore, the feedback of the ICC as indicated above in

introduction section (e) is addressed in this submission.

(g) Update on the implementation of measures to achieve the objectives of the biosphere reserve.

This periodic review submission is in response to the 2013 submission, which was not approved. It is our first attempt of the long form and the first comprehensive documentation since the 1976 nomination, when the expectations of the UNESCO MAB as well as the political context of environment regulation in the United States were different. We hope to demonstrate to the reader that most of Denali National Park's activities solidly fit within the MAB framework as defined in the 1995 Seville Strategy and that Denali National Park leadership and staff are committed to new activities that will enhance the Biosphere Region. In this report we have listed several active and long running partnerships that Denali National Park has and Preserve entered into in the context of our National Park work. Although our work is in line with Biosphere functions, the partnerships have not been entered into in the context of the existing Biosphere. For the purpose of the Biosphere, we aim to continue working with our partners and to engage them with the Biosphere objectives.

(h) Briefly describe the process by which the current periodic review has been conducted:

This Denali Biosphere Region (BR) periodic review resubmittal is the first significant attempt for Denali BR to come into alignment with the expectations of the UNESCO MAB program since the 2013 rejection on behalf of the ICC. As such, we have spent the last three months working diligently with other U.S. national parks in the BR review process, specifically Rocky Mountain BR, and the Alaska National Park Service Regional Office, to find a way forward for Denali BR Region to follow the UNESCO MAB programmatic and come into compliance of the following four issues highlighted by the ICC:

1. An updated periodic review report using the official periodic review form.

2. A zonation map showing a clearly defined core area, Managed Use Area (buffer zone), and Zone of Partnership and Cooperation (transition zone).

3. Continuation and integration of sustainable development in specific biosphere zones and around the biosphere reflecting human integration in the biosphere's ecosystems.

Key Denali National Park and Preserve staff have worked over the last three months to complete this resubmittal, in line with the official periodic form, and the advice gained from the UNESCO MAB workshop in Estes, Colorado (August 2016). We have worked to meet the requirements of the UNESCO MAB programmatic, because all of Denali National Park staff and partners find that value would be lost to this special place without of BR designation. Denali BR managers strive to share the successes and challenges of preserving a large intact ecosystem with high levels of visitation. The Denali BR acts as a reference point, not only for ecosystems, but for cultural and linguistic landscapes as well. We firmly believe that Denali is an important Biosphere Regions in the United States and global community, as evidenced by our longevity, strength of community, and the quality of natural, social and, cultural research produced within the Denali BR. Together, partners and research produce far-reaching effects of education within and about Denali's vital ecosystems and climate change to public and park managers that together decide the best way to manage preservation and sustainable development of the Denali BR. This effort has largely been indirect as interpreted through outcomes of public scoping, public meetings, environmental compliance processes, existing agreements, reports, annual meeting outcomes and staff work. This indirect context is rigorous and thorough as public engagement in park and BR's issues is comprehensive. There has been direct contact and discussion with our areas of partnership and collaboration and a reaffirmation of our agreements since the 2013

submission. Additionally good discussion and contributions from within the National Park Service management of the core, managed use area, and transition zones add context to this document.

(i) Area and spatial configuration:

Denali Biosphere Zones	Area (ha)	Latitude °N	Longitude °W
Total Area (all Zones)	18,032,453.64	63.11480°	151.19261°
BR Core zone (Denali Wilderness)	876,796.07	63.127055°	150.996094°
BR Managed Use Areas (New Park Additions, 1980)	1,532,857.47	63.342217° (North) 63.307748° (South)	151.193844° (North) 149.458008° (South)
BR Zone of Partnership and Cooperation (Game Management Units)	15,007,928.34	63.845512° (North) 62.557931° (South)	151.820031° (North) 152.215572° (South)
BR Park Road	154 km	63.748491° (at entrance)	149.128418° (at entrance)

(j) Human population of the biosphere reserve:

Humans have resided in Denali for over 13,000 years—the earliest site of human habitation reaching back 13,000 years ago (Holmes 1986). These people were neolithic migrants who traversed the Bering Strait land bridge, moving through ice-free corridors as they established themselves up and down the Pacific coast and some interior regions of North America. Due to the vast and remote nature of Denali, human settlement has always been sparse, though human migration, temporary settlements, and encampments have been a standard trend of human population in the region.

The BR utilizes established national standards for a census within the counties (boroughs) in which the BR is present. The BR utilizes community survey and community subsistence surveys from the Alaska Department of Fish and Game to tally human residence in Native villages (not captured by U.S. Census data).

The census units within BR and the zone of partnership and cooperation are Matanuska-Susitna (Mat-Su) Borough, Denali Borough, and the Yukon-Koyukuk Census Area. The Mat-Su Borough has by far the largest resident population at 101,095 in 2015; however, this Borough extends to encompass Anchorage's satellite towns, so that only a fraction of the Mat-Su population surrounds Denali.

The Denali Borough resident population declined from 1,970 in 2013 to 1,919 in 2015. These residents are most representative of the Denali BR's population. The demographic in this borough are primarily white in the 25-40 year-olds cohort. Alaska Native population the borough is 4%, which is astonishing when compared with the other population unit of Yukon-Koyukuk, which is over 72% Alaska Native. The Yukon-Koyukuk Census Area is not a municipal unit, and extends a great deal beyond Denali BR. Its south eastern portion rests within the BR, which captures the villages of Nikoli, Lake Minchumina, and Telida. Together, these native subsistence communities total 200 Athabascan persons (Collins 2004), of the total 5,533 persons in the entire Yukon-Koyukuk Census Area.

Noteworthy is the high summer seasonal human population of the BR, tourists and seasonal employees can be classified as acute, short-term amenity migrants. During any given summer evening, over 10,000 people are living in seasonal housing units, campgrounds and hotels within the Denali Borough. In all three census units, females comprise the majority of employed and higher educated (BA/BS and above) individuals, but also rank among the poorest and less likely to be owners of firms. This difference is quite high in the majority of the Mat-Su borough, but in Denali and Yukon-Koyukuk, this gap is smaller: 301 (male- non-minority owned), to 125 (female- non-minority owned), and 199 (male) to 132 (female), respectively. Overall, the population density of the BR itself lies between 0.1 and 0.005 people/km2.

(k) Budget (main sources of funds, special capital funds) and international, regional or national relevant projects/initiatives carried out or planned.

The budget in the previous report (2013): approximately $21 million and the current budget (FY2016) approximately $27.5 million. Annual budgets fluctuate between $20 and $30 million based on government appropriations and grant cycles.

(l) International, regional, multilateral or bilateral framework of cooperation. Describe, where applicable, the contribution of the biosphere reserve to achieve objectives and developing mechanisms that contribute to the implementation of international or regional bilateral or multilateral agreements, conventions, etc.

The Denali Biosphere Region enjoys several frameworks of cooperation including multilateral twinning agreements (described later in this document) as well as strategic regional agreements focused on research and education. We work with each regional collaborative as a partner in the advancement of mutual agendas such as education, conservation science and business opportunities in the context of growing populations and climate change.

We highlight below:

- The Denali Borough
- The Denali Chamber of Commerce
- The North and West Alaska Cooperative Ecosystems Studies Unit
- The Central Alaska Network (CAKN)
- The Alaska Climate Science Center
- Alaska Geographic
- Murie Center for Science and Learning
- The Denali Citizens Council
- The Denali Education Center

The North and West Alaska Cooperative Ecosystem Studies Unit

The North and West Alaska Cooperative Ecosystem Studies Unit brings together land management challenges with experts in Arctic and Subarctic anthropology, landscapes, ecology, archeology, and physical and biological sciences. The AK-CESU's mission is to create a collaborative partnership between academic and federal partners that delivers high quality science and human dimension expertise in Alaska's unique cultures and ecosystems to federal resource management, and environmental and research agencies that have responsibilities or interest in northern latitude issues. It strives to create and disseminate new knowledge for managing natural and cultural resources in the rapidly changing social, cultural, and environmental landscape of Alaska and the international circumpolar region.

With rapidly changing social and environmental contexts the region presents opportunities for innovative and creative resource management. The AK-CESU facilitate student research and internships opportunities that are pertinent to the needs of management agencies. The AK-CESU engages in agency specific issues and on issues concerning areas of mixed ownership and uses. In fact, one of its strengths is the

ability to identify and manage activities that require partnerships that involve two or more of its 20+ partners. Over the past decade, the Denali BR has engaged with the AK-CESU on several major long-term collaborative research projects including these highlights:

- Trans-boundary meso-carnivore population dynamics;
- Mercury and persistent organic pollutant contamination in subsistence fish resources;
- Modeling atmospheric transport of mercury and other persistent environmental contaminants to the region;
- Creating classroom based science activities based on an active climate science research agenda with the BR;
- Archeological excavations at Alaska's second oldest prehistoric site;
- Quantifying carbon stocks sequestered within permafrost soils;
- Archive and museum collection creation and management;
- Paleontological investigations on dinosaur trace fossils and cretaceous ecosystem characteristics;
- Social normative investigations on the effects of anthropogenic noise on visitor experience/

The Central Alaska Inventory and Monitoring Network

The Central Alaska Network (CAKN) is one of 32 vital signs monitoring networks across the National Park Service (NPS; Figure ES1). The Central Alaska Network comprises three units including Denali National Park and Preserve, Yukon-Charley Rivers National Preserve, and Wrangell-Saint Elias National Park and Preserve. Together these areas contain 4.7 million hectares of protected landscapes representing 25% of all lands in the US National Park System. The network

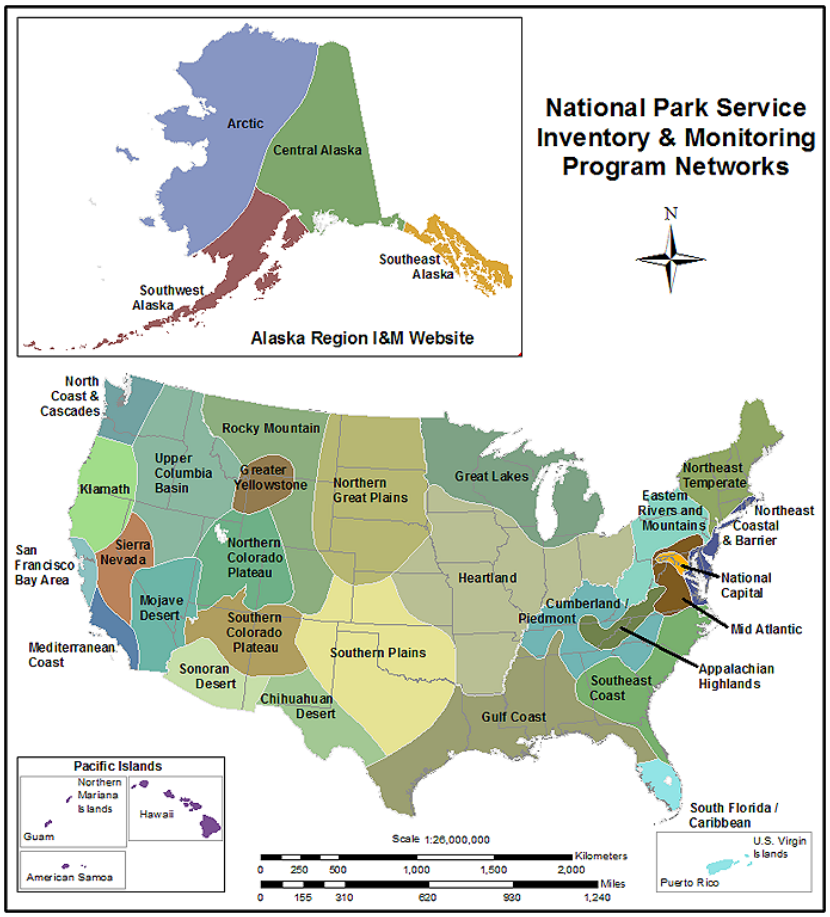


Figure ES1. A map of the National Park Service Inventory and Monitoring Networks.

approach allows investigators opportunities to monitor ecosystem process at subcontinental scales using rigorous and consistent methods intended for deployment for decades and centuries to come. Prior to creation of the CAKN, the BR functioned as one of seven long-term ecological monitoring prototype locations and Denali staff were responsible for setting the foundation of the CAKN. The Denali BR has had a close partnership with CAKN since its inception. Ecosystem attributes are collaboratively prioritized for monitoring attention and staff and financial resource are shared.

The primary goals of the NPS Inventory and Monitoring Program are to:

- Inventory the natural resources under National Park Service stewardship to determine their nature and status.
- Monitor park ecosystems to better understand their dynamic nature and condition and to provide reference

points for comparisons with other, altered environments.

- Establish natural resource inventory and monitoring as a standard practice throughout the National Park System that transcends traditional program, activity, and funding boundaries.

- Integrate natural resource inventory and monitoring information into National Park Service planning, management, and decision making.

- Share National Park Service accomplishments and information with other natural resource organizations and form partnerships for attaining common goals and objectives.

Alaska Climate Science Center

The Department of the Interior's Alaska Climate Science Center (CSC) partners with natural and cultural resource managers to provide science that helps fish, wildlife, ecosystems, and the communities they support adapt to climate change. The North Central Climate Science Center is located at the University of Alaska-Fairbanks, and serves the BR through workshops, conferences and projects. The Climate Science Centers:

- Conduct cutting-edge research projects at local, regional, and national scales; and produce products that include climate, water and ecosystem modeling, and geospatial, habitat, and species-level data.

- Are built upon federal agency-university partnerships, and are dependent upon engagement with a community of stakeholders to define research priorities and initiatives.

- Provide educational opportunities for students and early career scientists through fellowships, workshops, and trainings.

- Work with tribes and indigenous communities to better understand their specific vulnerabilities to climate change and to help them adapt to these impacts.

The Alaska Climate Science Center has established a specific program of research and collaboration, guided by the AK CSC Strategic Plan, to discover how Alaska's ecosystems are dramatically and rapidly responding to climate change. Five basic research approaches include:

1. Applied research into improving the capacity to downscale and apply GCMs (global circulation models) including identification of factors affecting performance

2. Monitoring and development of indices to detect changes in ecosystem components and provide data for modeling and context for process studies

3. Integration of physical climate models with ecological, habitat, and population response models

4. Retrospective studies to maximize use of existing long-term observational records

5. Modeling to synthesize, extrapolate to temporal and spatial frameworks, test ideas, and forecasting future scenarios.

Recent and ongoing projects in the Denali Biosphere Region include:

Glacier impacts on current and future streamflow:

This project goes beyond improving theoretical understanding of glacier-influenced hydrology and building operational tools for other scientists, this project helps citizens by providing improved historical and projected statistics of streamflow. This will be done by sharing the software and raw data of the modeling process through internet-standard protocols and developing a web portal specifically designed to allow users to explore content, access data, and view results through map-based and statistical visualizations. This will help the general population understand (1) the state of available resources, (2) potential

responses of hydrology to changes in climate and glacier extent, and (3) uncertainty of model simulations associated with use of historical and projected future climate data. The development of this information can support the assessment of potential hazards (such as ice dam failures) and decision-making for more resilient development and risk management.

Differential effects of climate-mediated forest change on the habitats of two ungulates important to subsistence and sport hunting economies:
Climate change is a complex process that may affect the food resources of different species of wildlife in contrasting ways. Moose and caribou are important to both subsistence and sport hunting economies throughout Alaska, but their winter diets are quite different; caribou focus on snow covered ground hugging lichens while moose focus on the twigs of erect deciduous shrubs that protrude above the snow. This project will use output from the Integrated Ecosystem Model to estimate the differential effects of climate change on the quantity of food available to these two species throughout most of Alaska and parts of Canada, ~1970-2100. The model integrates the expected effects of climate on lichen and shrub production, wildfire and resulting plant community change, and the restrictions to food availability caused by deep snow and ground icing as a result of rain-on-snow. The results will be stratified by land ownership and landscape characteristics to provide maps of expected changes in winter food for moose and caribou that will be tailored to and directly useable by natural resource managers as they devise strategies for adapting to a changing climate.

Development of an Alaska-based research framework for migratory waterfowl:
Migratory waterfowl that breed in Alaska routinely travel thousands of miles in their annual migrations among breeding, stopover and wintering ranges. The effects of climate and land use on their survival and productivity varies along the migratory routes and population trends result from the cumulative effects of habitat quality and climate throughout their annual range. It is unlikely that the direction or strength of climate and habitat change are consistent among ranges and, as a result, it is extremely difficult to unravel the most important effects on population size when potentially contrasting positive and negative influences of climate and habitat occur within a year at widely separated locations. A very large scale research framework or strategy is needed to deal with the complexity of this problem and increase the relevance, efficiency and effectiveness of research studies and resulting management. Using an intensive review of the scientific literature to identify knowledge gaps and a survey of expert opinions of researchers and managers this project will identify what types of information are most critical for the development of a focused and integrated multi-regional research program and the best ways for researchers and managers from seasonal ranges to communicate in common terms.

SOLVES model (Social Values in Ecosystem Services)
This model is used to assess visitor social and environmental values. Surveys conducted in the BR during the summer tourist season are used to assess visitors' experience in the BR with evidence of human use (e.g., trails, litter), or encounters with wildlife, encounters with other visitors or BR staff. These surveys also target individuals' background knowledge of the BR, ecosystems and climate in general, as well as their environmental worldview they bring with them when traversing the BR. These data are used in consort with ongoing monitoring and inventory of ecological and physical data from the BR, including plant community change, air quality and natural or human-caused noise fluctuations, habitat change, and shifting geohazards. Through SOLVES, we know how people who visit and inhabit the BR both feel about, and how they fit, into the BR system. Knowing this can help improve management of sustaining the ecosystem integrity of the BR.

Potential effects of a warming climate on visitor use in three Alaskan national parks
The paper examines the potential effects of warming climate on park visitor season of use in three of Alaska's national parks. Based on

historical relationships among temperature, visitor use, and increased temperatures associated with climate change, the paper suggests that peak season of visitor use could expand into May and September depending on the park, the climate scenario, and the time period. As a consequence of a warming climate, planning by the National Park Service and other stakeholders may need to consider this transition in temperatures and the potential for an extended peak season of visitor use, along with other climate-related changes (e.g., extreme weather), climate-induced environmental changes, and shifts in recreational opportunities that will likely accompany climate change.

Bonanza Creek long-term ecological research program

The Bonanza Creek Long-term Ecological Research (BNZ LTER) program collaboratively works with protected areas, including the Denali BR, BR staff, and researchers from the University of Alaska-Fairbanks. The BNZ LTER program is designed to understand the interactive effects of changing climate and disturbance regimes on the Alaska boreal forest, and study associated consequences for regional feedbacks to the climate system, and sustainability of subsistence Alaskan communities. Particularly, this project asks: how is the boreal biome responding to climate change and what are the local, regional, and global impacts of those responses?

The Murie Science and Learning Center-Alaska Geographic Field Institute

Alaska Geographic (AK-Geo) is a non-profit that aims to foster deeper connections to Alaska's wildest places, inspiring people to engage as stewards of their public lands, natural resources, and cultural heritage. AK-Geo is partner to the National Park Service (that manages the Denali BR), U.S. Forest Service, U.S. Fish and Wildlife Service, and the U.S. Bureau of Land Management. AK-Geo's primary aim is to nurture greater opportunities to learn, explore, and give back to Alaska's wildest places and make public lands a valued asset for our future. AK-Geo strives to get people outside, foster deep commitments to their wild places, and overcome barriers to more people benefiting from outdoor spaces both close and far from home. AK-Geo shares the facility and provides funding for many of the learning and outreach activities by the Murie Science and Learning Center, a National Park Service center.

The mission of the Murie Science and Learning Center (MSLC) is to promote science and stewardship on behalf of national parks in northern Alaska. Specific goals include:

- Engage the public with park science through interactive learning and research programs.
- Enhance the public's understanding of how parks use science to make management decisions.
- Share scientific findings in timely, compelling, and understandable ways.
- Use partnerships to enhance outreach offerings.

The Murie Science and Learning Center is situated at the entrance to Denali National Park and Preserve. The operations of the facility are funded and facilitated by the National Park Service and its MSLC Managing Partner, Alaska Geographic. The MSLC is one of 19 Research Learning Centers operated by the Park Service nationwide. Research Learning centers seek to increase the amount of scientific research in the national parks and thus the effectiveness of science-informed decision making, and to make that science accessible to the public.

Many educational programs are offered through the MSLC each year. Programs for youth include camps, field trips, classroom visits (in person and via videoconference), and activity guides. Programs for adults and families include field courses, bus excursions, an evening lecture series, and science presentations. Visitors to the MSLC are invited to explore current science topics through a range of physical and digital museum exhibits.



ED O'CONNER

Students use radio telemetry equipment to learn how Denali scientists track wolves during a Murie Science and Learning Center youth program.

The Center is situated at the entrance to Denali National Park and Preserve. The operations of the facility are funded and facilitated by the National Park Service and AK-Geo. The MSLC is one of 19 Research Learning Centers operated by the National Park Service nationwide. Research learning centers seek to increase the amount of scientific research in the national parks and thus the effectiveness of science-informed decision making, and to make that science accessible to the public.

The Denali Citizens Council

Denali Citizens Council (DCC) works to promote the natural integrity of the Denali BR by supporting the ecological and wilderness values for which the park and preserve was established, and for which the BR was designated. The DCC fosters responsible planning in the greater Denali park community by supporting efforts to:

- Preservation of wildlife and wilderness is the primary goal. Direct experience of wild nature by park visitors is valued and protected.
- Park ecosystems exist in a natural and minimally managed condition.
- The park is a haven for natural sounds, where motorized vehicles and aircraft do not disrupt the natural soundscape.
- Travel on the park road is a unique journey through wild, primitive lands with unmatched opportunities to observe wildlife and wild landscapes. This unique road character is protected through careful maintenance, limited vehicle access, and minimal presence of infrastructure.
- Kantishna is a remote outpost of human activity, where commercial enterprises remain small, few in number, and are characterized by nature-oriented activities for their guests. Experiences there provide a genuine feeling of wildness for park visitors, where the landscape shows minimal impact of humans.
- Communities in the Denali region practice environmentally sustainable development and retain their small town character and rural lifestyles. Architectural and landscape design complement the magnificent scenery, resource development is subject to

public oversight and local residents enjoy ready access to wild lands and wildlife "out the back door."

- Local communities embrace their role as part of the gateway to Denali National Park and Preserve, appreciate their location next to a national park, and recognize the importance of the greater Denali ecosystem.

- Wildlife habitat values on lands that are part of the greater Denali ecosystem are protected.

The Denali Education Center:

The mission of the Denali Education Center is to promote understanding and appreciation of Denali through informative and inspiring programs. The Denali Education Center, known as Denali Foundation before 2007, was established by the Denali BR (Denali Park Concessionaire and the Denali National Park Superintendent). Their vision was to create a non-profit to support research in the Park and serve as a meeting place for ideas; where researchers would share their findings with conservation professionals, guides, visitors, and the local community. Denali Foundation was incorporated as a 501(c)(3) non-profit organization in November 1989.

Since then, the DEC has offered residential education programs in Denali in partnership nonprofit and affinity groups including Road Scholar. These residential programs bring people from far and wide to the Park for a full week of exploring and learning about subarctic plants, animals, and ecology. As support for research in Denali became a top priority for other organizations, our primary focus became educational programming.

2016 marks the 27th season offering residential programs and we continue to support research in the park through the Discover Denali Research Fellowship. Through the years our educational programs have grown and diversified to include: summer camp programs for local youth and at-risk and developmentally challenged youth; naturalist-led day programs for park visitors; and lectures, concerts, and workshops for the local community.



NPS/KATIE THORESEN

Denali National Park and Preserve was originally created to protect wildlife, such as Dall's sheep.

PART II. PERIODIC REVIEW REPORT

Section 1. Introduction

Mount McKinley National Park was established in 1917, one year after the U.S. National Park Service was established. Its creation was inspired by an abundance and diversity of charismatic wildlife that was in jeopardy due to market hunting. Both local and visiting people believed this was a special place to protect as a game reserve, as a place for the freest form of recreation, and for the perseveration for future generations. In 1976, Mount McKinley National Park was designated a Biosphere Region as part of the first generation of BR nominations. In 1980, it was expanded and renamed to Denali National Park and Preserve.

Now the Denali Biosphere Region is a hub of biodiversity conservation, research, recreation, and an affirmation of natural wonder for people from all over the world. As the park celebrates its 100 year anniversary, it is clear that today the park is a rare example of an intact, un-manipulated ecosystem that serves as an important reference for managed ecosystems. It provides inspiration and recreational opportunities to 500,000 visitors annually and helps drive a robust local and regional economy. This conservation unit enjoys tremendous support from local and international communities. Conservation, sustainable development, subsistence harvest, and the preservation of ethnographic and cultural resource is successful through numerous partnerships and a shared commitment to sustainability.

Below is pictured the historic entrance to the national park, then about 1.5 million acres. Today, the Denali Biosphere (and national park) includes more than 6 million acres.

NPS



NPS/JAY ELHARD



Caribou are an important subsistence resource for local communities and are the subject of long-term monitoring.

Section 2. Significant Changes in the Biosphere Region, 1976-2016

Significantly, cultural resources within the BR have been significantly advanced in project diversity, inventory, monitoring, and funding since the last Denali BR summary periodic review in 2013. Notably, the Alaska Place Names project has contributed to the growing and steady recognition of indigenous knowledge, culture and traditions within the Biosphere Region. Additionally, coordination with partner Alaska Geographic and the Murie Science and Learning Center has provided countless opportunities for engagement with the public, especially through distance learning and scholarships for underprivileged youth, as well as active restoration of biodiversity.

The geophysical and ecological understanding of the BR has also advanced substantially. In 2016, we celebrate a 30-year legacy of detailed demographic monitoring of the BR's wolf, caribou, Dall's sheep, and golden eagle population monitoring. Robust research campaigns on permafrost dynamics and atmospheric chemistry have also been occurring for decades.

2.1 Brief summary overview: Narrative account of important changes in the local economy, landscapes or habitat use, and other related issues. Note important changes in the institutional arrangements for governance of the biosphere reserve area, and changes (if any) in the coordinating arrangements (including the biosphere reserve organization/ coordinator/manager) that provide direction for the biosphere reserve. Identify the role of biosphere reserve organization/coordinator/manager in initiating or responding to these changes.

While climate change has affected the landscape and wildlife habitat use and the economy has grown, a significant change for the Denali Biosphere Region was learning through the 2013 periodic assessment process that the biosphere, as designated in 1976, did not meet the post Seville Strategy standards required of a UNESCO-MAB Biosphere Region.

An effort to reinvigorate the program within the U.S. and specifically with the U.S. National Park Service, which is the lead managing agency of the Denali BR, began in 2014 and with the help of the Rocky Mountain BR, we present this report! We have worked with numerous people to advance a way forward and to understand the statutory framework and how it relates to U.S. laws. To be forthcoming, there is not a 1:1 relationship if one focuses on form over function. However, if one looks at the functional elements of the statutory framework, we demonstrate the collaborative nature in which we work within and beyond our administrative boundaries to advance conservation and sustainable principles. Denali National Park and Preserve on behalf of the Denali BR is dedicated to remaining within the UNESCO-MAB, (as demonstrated in the effort to complete this report) because we highly value the international connectivity of protected areas, the value added to this unique place due to international recognition as a BR, and a strong desire to increase protected areas and conservation activities in the world. We offer that at this time in the history of our planet, we need more people, institutions and landscapes on the path towards a sustainable future, with open cooperation in the conservation of biodiversity. We invite you to take this into consideration when judging our review.

2.2 Updated background information about the biosphere reserve.

In 1980, with the passage of the Alaska National Interest Lands Conservation Act (ANILCA), Mount McKinley National Park was expanded from 809,373 ha (2,000,000 acres) to 2,428,118 ha (6,000,000 acres) and its name was changes to Denali National Park and Preserve to reflect the indigenous name for the tallest peak in North America. The 1980 additions align perfectly with the Seville Strategy Biosphere Region model in that pre ANILCA park boundary functions as the core zone, and the 1980 park addition function as the Managed Use Area. Stretching far beyond the boundary of the national park are the State of Alaska's Game Management Units (GMUs) that function as a transition zone and for the purpose of this report are referred to as the Zone of Partnership and Cooperation. In 1997, Denali Frontcountry Development Concept plan refined objectives for the managed entrance area of the Core Zone and set goals for sustainable development in the park's entrance area and along the 154 km (96 mile) Denali Park Road. These ambitious development goals have all been achieved as of August 2016.

2.2.1 Updated coordinates (if applicable). If any changes in the biosphere reserve's standard geographical coordinates, please provide them here (all projected under WGS 84):

63.1148°N, 151.1926°W

2.2.2 If necessary, provide an updated map on a topographic layer of the precise location and delimitation of the three zones of the biosphere reserve Map(s) shall be provided in both paper and electronic copies. Shape files (also in WGS 84 projection system) used to produce the map must also be attached to the electronic copy of the form.

If applicable, also provide a link to access this map on the internet (e.g., Google map, website).

2.2.3 Changes in the human population of the biosphere reserve.

The population of the Denali Borough, the primary borough containing the BR, is 1,919 with a population density of 0.1 persons/ km2. From 2010, the permanent population of the Denali Borough has increased by 100 people. The median household income of the BR is $79,167 in 2015 U.S. dollars. The number of employer establishments in Denali Borough (includes the BR communities in the zone of cooperation and partnership of Healy, Cantwell, Anderson) is 120 from the last American Community Survey (PUMS) - a micro-census conducted by the U.S. Census authority. Local firms number 450.

About 7.9% of the population lives in poverty. Poverty means a familial unit lives below the calculated poverty threshold per family size.

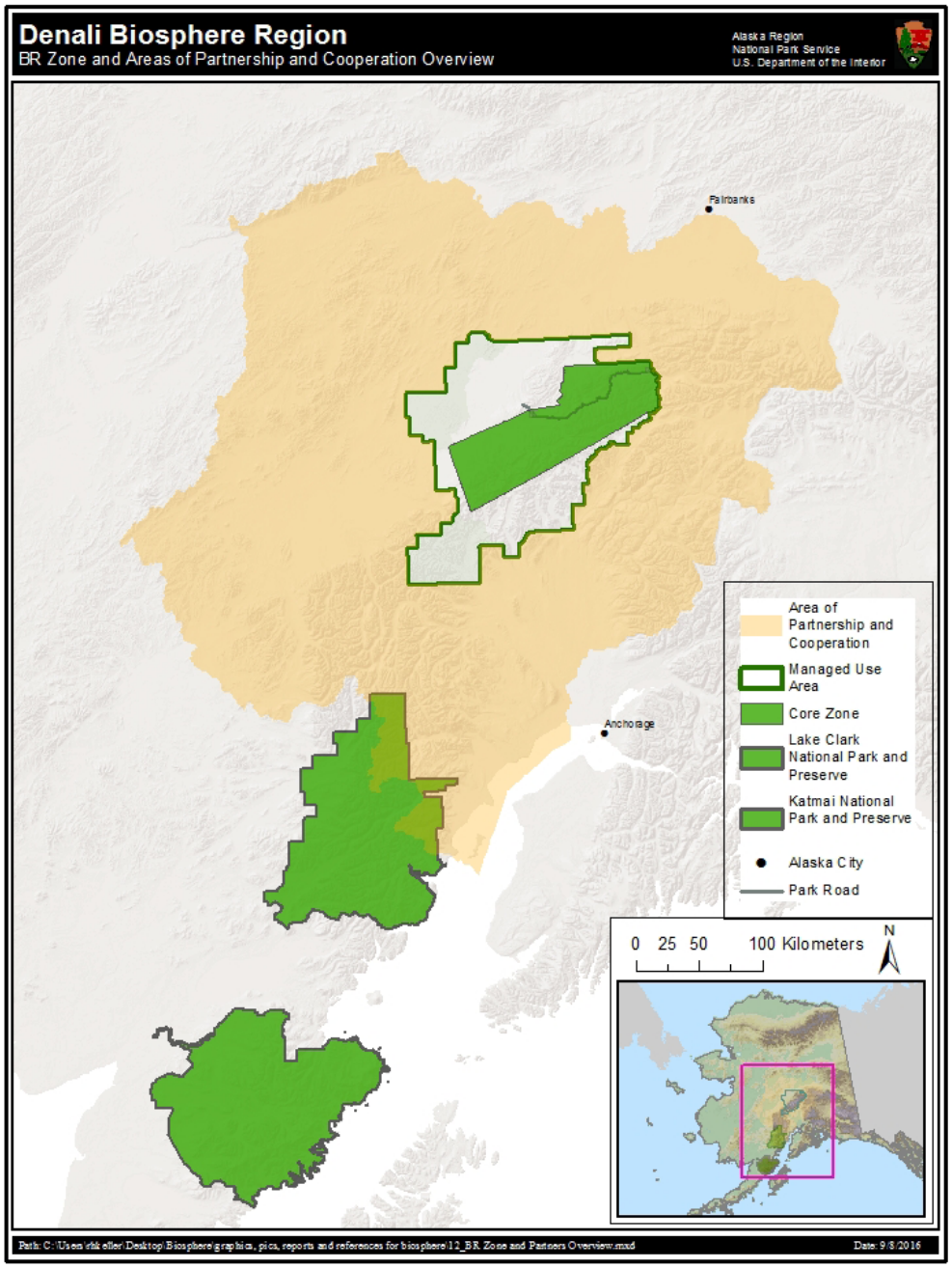


Figure 2.2.2. A map of Denali Biosphere Region Zone Overview.

While the permanent population of the BR is not growing, visitation and seasonal population growth is up about 30% over the last decade. This growth suggests the BR supports job growth in especially the tourism sector. However, it also signals potential impacts to conservation due to the rate of growth. The BR's adaptive management strategy allows an inventory-monitor-adapt approach to promote conservation and sustainable development with the BR local partnerships. Commercial activities within the BR are regulated as to not degrade the resources fundamental to the National Park and BR's purpose.

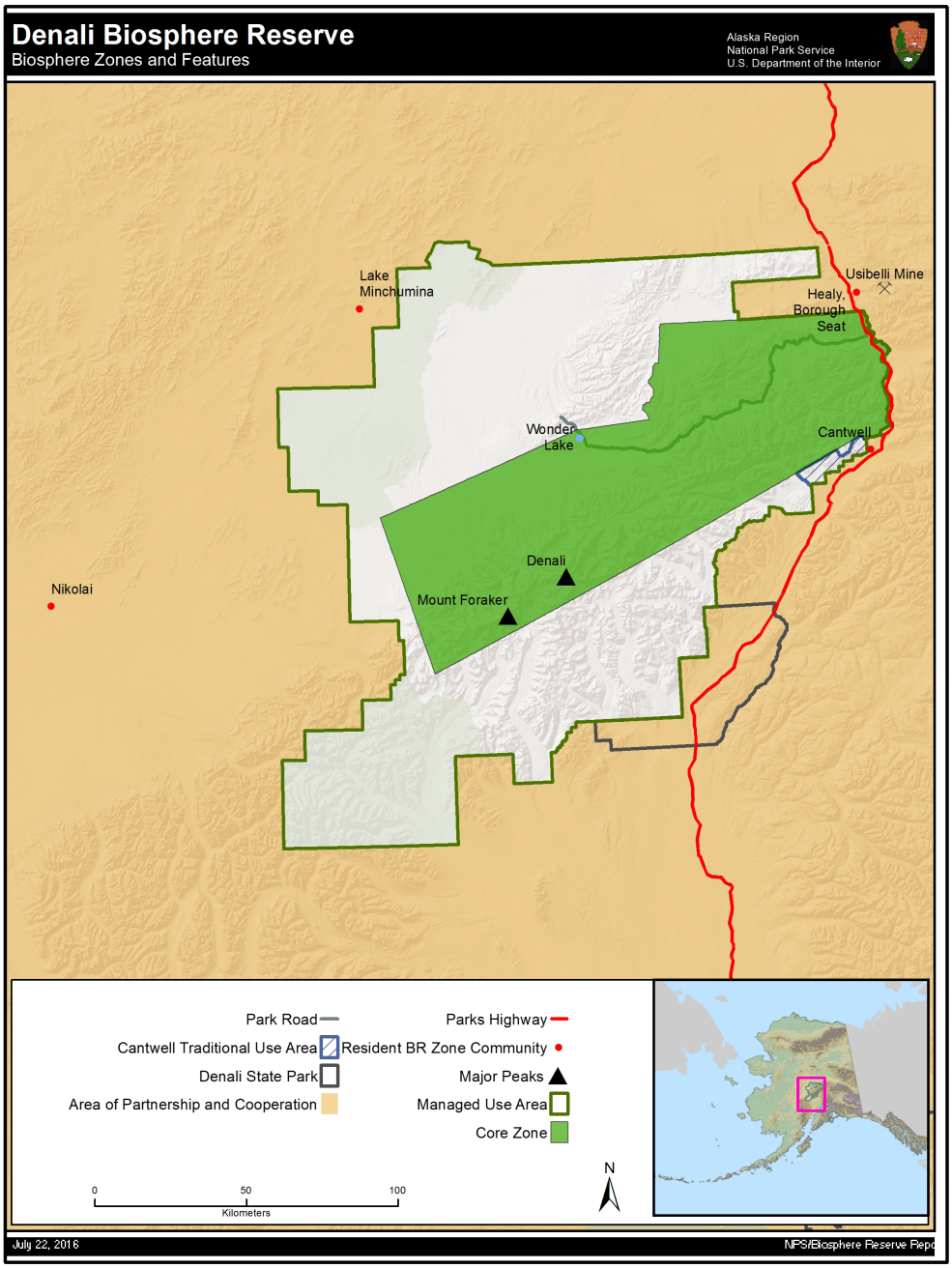


Figure 2.2.3. A map of Denali Biosphere Region Inner Zones and Features.

2.2.4 Update on conservation function, including main changes since last report.

Conservation as one of the foundational purposes of the BR remains unchanged since the Denali BR was designation in 1976. Sharing this site while maintaining it in an unimpaired state for future generations is the cornerstone of NPS management of the BR's Core and Managed Use Zones. Monitoring changes in the structure and function of the BR's ecosystem remains the primary goal of the BR's science team and by extension, the focus of much research conducted by partners and academic investigators. Notably, the conservation function, and Vital Signs of the BR has been served since the 1980s by the Central Alaska Inventory and Monitoring Program (CAKN); such changes and a series of reports are available on the CAKN website. The BR also has a repeat photography website (very much worth looking at) that demonstrates these changes with photographic pairs that were, in many cases, taken 100 years apart. The vast majority of the changes are attributed to natural succession and climate change.

The BR science staff has grown to embrace a scientific method of serving conservation in the BR beyond that of pure inventory reporting. Now, science in the BR serves the conservation function by reaching to the wider scientific community, building cross-comparative research both regionally and nationally to track changes in the BR, and how best to adapt conservation policies to preserve the invaluable ecosystem services of Denali. To this end, we have established an impressive array of national and international partnerships with universities, non-profit organizations, businesses, and other State and Federal Agencies, with whom we work together to conserve landscapes beyond the BR border, as conservation science today demands a more holistic, interconnected approach that includes human dimensions to preserving unique areas in the world. We also are looking to the future to establish a BR network and corridor of other IUCN category II protected areas, such as other National Parks, that connect to the Denali BR Zone of Partnership and Cooperation (transition zones). This will be especially invaluable to conservation of wolves, as their range is larger than any single preserve can encompass. Furthermore, we are seeking to build this corridor to extent across the border to Canadian reserves such as Kluane National Park, and building up our areas of international Partnership with the Canadian Land Conservancy. The Denali BR also plans to develop relationship with BRs and other protected areas in South America and Eurasia where many of the regions migratory birds winter. Learning the location of the BR's migratory song birds is a current research initiative. Section 4.1 and 4.2 detail the conservation function of Denali.

2.2.5 Update on the development function, including main changes since last report.

The development of a clean fuel shuttle system to access the interior of the BR; an increase in recycling and composting; the significant reduction in the use of water and energy are key elements to community advancement in sustainable development principles. Denali National Park is also a pilot park for the zero-landfill initiative. This is a monolithic task, given Alaska's poor recycling network, waste services, and relative isolation of the Denali BR and transition zone communities. We have already made great strides to reduced waste to the landfills, and continue to work closely with community organizations, non-profits, businesses, the tourism sector, other Parks, the State of Alaska, and multi-national corporation Subaru. Section 5.1, 5.2 detail the development function.

2.2.6 Update on logistic support function, including main changes since last report.

Research and monitoring has grown significantly over the last decade as the BR's inventory and monitoring program grew from an experimental pilot to fully funded program with peer reviewed protocol driving the monitoring campaigns described in section 1. In addition, between 15 (2013) and 40 (2012 and 2015) institution based researchers use the BR as a platform to study a diverse array of social, biological, and physical phenomena annually. During the last decade the BR has hosted one major research conference open to the public, have had dozens of strategic workshops to advance science initiatives and engaged with tens of thousands members of the public on plans informed by this science. Section 6.1, 6.4, 6.6.1 especially detail the logistic function of the BR.

2.2.7 Update on governance management and coordination, including changes since last report (if any) in hierarchy of administrative divisions, coordination structure.

As noted in section 7 of this document, governance is specific to the authority in charge (see section 2.3 below). The ability to govern in a coordinated way is facilitated through interagency (U.S. Department of Interior) and cooperative agreements, and formal and informal partnership.

2.3 The authority/authorities in charge of coordinating/managing the biosphere reserve.

The primary authority for the Biosphere Region is the U.S. Department of the Interior,

National Park Service, Denali National Park and Preserve. This authority is responsible for the management of the core, managed use, and transition zones. You will find a detailed explanation in section 7 of this document. The National Park Service influences management activities in the Zone of Partnerships and Cooperation through Agreements, and formal and informal partnerships and collaborations.

2.3.1 Updates to cooperation/management policy/plan, including vision statement, goals and objectives, either current or for the next 5-10 years.

Per the description in 2.3, the primary plans controlling BR management are with the National Park Service. The Foundation Statement set the overarching objectives for the BR's Core and Managed use Zones' management based on legislation, law, and policy. The BR status is called out in this document. This document essentially is intended to last for many decades and to be used as a foundation for all plans. Management plans provide guidance to park managers on various topics and activities. Typically these plans are created based on the outcomes of environmental assessment and impact statement listed above. Denali National Park and Preserve currently has in place the following management plans:

A. Management Plans.

Denali National Park and Preserve's Portfolio Management Plans provide guidance to park managers on key topics that BR is responsible for managing. We call out eleven primary plans for managing the BR, providing overviews of the following thirteen key management plans. The Vital Signs Monitoring Plan, and Bear-Human Conflict Plan, are further highlighted in Sections 3 and 7, respectively.

1. General Management Plan 1986 (https://www.nps.gov/dena/learn/management/generalmanagementplan.htm)

2. Foundation Statement (https://www.nps.gov/dena/learn/management/upload/FoundationDoc_Denali_2014_corrected_final.pdf)

3. Denali Resource Stewardship Strategy 2008-2027 and Director's Order #100: Resource Stewardship in the 21st Century. (https://www.nps.gov/dena/learn/nature/rss.htm)

4. Wilderness/Backcountry Management Plan 2006 (https://www.nps.gov/dena/learn/management/upload/Denali%20Backcountry%20Management%20Plan.pdf)

5. Frontcountry Plan (https://www.nps.gov/dena/learn/management/frontcountryplan.htm)

6. Southside Plan (https://www.nps.gov/dena/learn/management/southdenaliplan.htm)

7. Fire Management Plan 2015-2019 (https://www.nps.gov/dena/learn/management/firemanagement.htm)

8. Vehicle Management Plan (https://www.nps.gov/dena/learn/management/roadvehmgteis.htm)

9. DOI Bureau of Land Management East Alaska Resource Management Plan (http://www.blm.gov/ak/st/en/prog/planning/east_alaska_plan/east_frmp.html)

10. Denali Borough Land Management Plan (http://www.denaliborough.govoffice.com/vertical/sites/%7B63112C6F-13FC-4147-831D-8F3F0E33EC53%7D/uploads/Comp_Plan_Rev_3_FINAL_09-09-15.pdf)

11. State of Alaska Department of Natural Resources Land Management Plan (http://dnr.alaska.gov/mlw/planning/mgtplans/n_access_visitor_facilities_study/pdf/3land_management.pdf)

12. Education Plan (https://www.nps.gov/dena/learn/management/upload/DENA%20Ed%20Plan%20-%20complete.pdf)

13. Bear-human Conflict Plan (https://www.nps.gov/dena/getinvolved/upload/bear-human-conflict-plan-2003.pdf)

Management plans are preceded an Environmental Impact Statement (EIS) or Environmental Assessment (EA) so that the impacts of alternative management strategies can be evaluated with public input. Management plans are made available for public review and comment through the National Park Service: Projects Management and Information System.

1. Foundation Statement. The Denali National Park Foundation Statement describes the overarching purposes of the National Park and BR. All other planning efforts tier of the areas purposes as it is describe in the Foundation Statement. It includes the:

a) Purpose Statement of founding the park, why the area was set aside as a unit in the National Park System.

b) Significance Statements of the importance of the park's natural and cultural resources.

c) Fundamental resources and values (specific, unique qualities of the park that provided justification for its establishment) and other important resources and values (a growing body of resources that have been included because they are important for the park management, visitor experience, and community engagement). These resources fall within the general law and policy guidance of the National Park Service, including the general direction for all the Alaska National Interest Lands Conservation Act (ANILCA) conservation system units.

d) Primary Interpretive Themes that describe the key histories, concepts and educational frameworks that help the public understand and appreciate the purpose and ecological, cultural significance of the park/biosphere. These themes are the foundation upon which all educational programs (interpretation) are based.

e) Special Mandates and Administrative Commitments, reflect the broader connection Denali has in the international community in education, research, ecosystem services, and conservation. The Denali Biosphere is a special mandate of the park.

B. General Management Plan 1986. Laid the foundation and mission of the park/biosphere in operational guidelines to which all other management plans, strategies, and projects must adhere.

C. The Trails Plan (under development) will provide the guiding principles of managing human impact to the park/biosphere by establishing trails to channel human use and access, as well as providing a guiding framework for managing the park/biosphere's predominantly trail-less areas. This plan establishes guiding principles for cooperating with local community guided hiking, excursion tours in Denali to allow benefit accrual on the part of local tourism business while ensuring a minimal impact to the BR's wilderness character, cultural resources, while providing for visitor enjoyment.

D. Denali Resource Stewardship Strategy (RSS) provides strategic guidance for the research, resource management, and resource education programs of the BR. The RSS provides the park with a strategy for investing both human and fiscal resources in the stewardship of natural and cultural resources. It also reports accountability toward progress in attaining and maintaining desired resource conditions in the BR. The final step in the development of the RSS was the development of comprehensive strategies, programs, and projects to assure that the National Park Service, Denali National Park is attaining and maintaining the desired condition of each Park and Biosphere Region resource (Table 2.3.1).

1. The RSS identified 119 indicators of resource conditions to monitor for continuous stewardship and adaptive management in changing local environmental to macro climatic conditions.

2. A research program has been established to identify indicators related to visitor experience and means to encourage

Table 2.3.1 Resource Stewardship Strategy for Denali Park and Biosphere Region.

Base Knowledge of Park Resources	Strategy A: Complete biological, physical, and cultural resource inventories Strategy B: Develop an understanding of basic ecological relationships necessary for management decision-making. Strategy C: Develop the historic contexts necessary to evaluate resources and generate nominations for National Register significance.
Monitoring Resources	Strategy D: Develop and implement vital signs monitoring protocols for physical and biological resources to monitor long-term ecological systems change. Strategy E: Monitor natural resources that may need management response.
Management and Mitigation	Strategy F: Develop and implement plans to monitor and manage vulnerable park resources. Strategy G: Restore and monitor disturbed lands. Strategy H: Determine and monitor visitor carrying capacity by management area. Strategy I: Minimize habituation of park wildlife to people Strategy J: Detect, monitor, and mitigate environmental influences external to the local natural ecosystem. Strategy K: Mitigate the risk of wildland fire to park infrastructure and cultural resource sites. Strategy L: Preserve the museum collection and rehabilitate and preserve park historic structures. Strategy M: Monitor and manage consumptive uses of park resources, including subsistence use. Strategy N: Enhance and increase the effectiveness of wildlife protection by deterring illegal activities.
Parks and People	Strategy O: Improve estimation of park visitation Strategy P: Monitor trends in adjacent community populations, land use and local economy.
Data Management	Strategy Q: Develop and implement effective data management strategies for use by managers, specialists and the public.
Education and Communication	Strategy R: Facilitate the education of all audiences about resource issues in and around Denali Park and Biosphere to gain support for the continuous management of resources to preserve ecosystem integrity. Strategy S: Develop staffing and infrastructure to enhance bridges between research and education, and to facilitate higher levels of understanding and preservation of resources from a local to global level.

environmentally conscious behavior within the park/biosphere and outside it.

3. Ecosystem integrity and systems connectivity targets have been established for 80 of the 119 indicators, research is being conducted nowadays to establish the targets of the remaining 29 indicators.

4. The new Director's Order #100 mandates the adoption of a revised Resource Stewardship Strategy for the 21st century

that focuses the overarching goal of resource management to the stewardship, education and research of Park and Biosphere resources for continuous change in this era of environmental and climatic flux. The National Park Service, and by extension the Denali Biosphere Region prepares the management and researchers of the NPS to continue the enduring responsibility to:

a) Preserve and restore ecological, historical, and cultural integrity that includes multiple perspectives;

b) Provide visitors and users of the park and biosphere managed use area and transition zone with opportunities for transformative experiences that educate and inspire;

c) Contribute as an ecological and cultural core of a national and international network of protected lands and waters.

5. Wilderness and Backcountry Management Plan 2006.

The goal of the backcountry management plan is to describe how the BR will act to provide future generations with a variety of opportunities to experience the Denali backcountry while protecting park wildlife and other natural resources, wilderness resource values, and subsistence resources. This plan updates the 1976 Backcountry Management Plan and amends the 1986 General Management Plan for Denali National Park and Preserve. This plan will also serve as a Soundscape Preservation and Noise Management Plan as required by NPS Director's Order 47, a Wilderness Management Plan as required by NPS Director's Order 41, and a Commercial Services Plan for the backcountry. This new plan addresses management of all BR core, managed use area, and transition zones except the BR road corridor and adjacent development zones and backcountry day-use areas, which were addressed in the 1997 Entrance Area and Road Corridor Development Concept Plans. The study area also includes the road corridor west of BR headquarters during the winter season. Some actions do affect the development and backcountry day-use areas delineated in the 1997 Entrance Area and Road Corridor Development Concept Plans; the new actions proposed in this plan, however, are consistent with the Entrance Area and Road Corridor DCP and the 1997 South Side Denali DCP. The plan is intended to guide decision-making for the backcountry areas of Denali for 20 years.

Specifically, actions described by this plan

- protect and preserve the park's natural and cultural resources, including natural soundscapes and subsistence opportunities;
- protect and preserve Denali's wilderness resource values, including its wilderness character and outstanding opportunities for solitude;
- provide for the public's freedom of use and enjoyment of the Denali's backcountry and wilderness in a manner that is consistent with park purposes and the protection of park resources and values;
- protect and provide opportunities for wilderness recreational activities in the backcountry, including reasonable access; these recreational opportunities should be defined within the context of a spectrum of recreational opportunities available on lands managed by public agencies in the Denali region (primarily state parks, other state lands, and federal Bureau of Land Management lands);
- ensure all BR and National Park Service management practices and research activities in the backcountry are consistent with park purposes; and
- provide for the means to achieve public understanding and support of backcountry and wilderness values.

6. Fire Management Plan 2015-2019

Though seldom seen by visitors, periodic, large-scale fires burn across Denali National

Park and Preserve. The National Park Service manages ninety-three percent of the park as a Limited Management Option. This category recognizes areas where the cost of suppression may exceed the value of the resources to be protected and the exclusion of fire may be detrimental to the fire dependent ecosystem. The primary management strategies protect human life and specific resources and allow fire to contribute its natural role in the ecosystem. This plan reflects on the 2008-2012 Wildland Fire Management Strategic Plan and captures the changes in thinking about how NPS manages wildland fire through people, partnerships, and understanding of the changing ecological, social and economic environment in and around NPS lands. This plan describes what wildland fire management leadership considers the best course of action to meet the NPS mission, and how it can be effectively implemented. The NPS Fire Management Leadership Board (FMLB) provides leadership for the NPS Wildland Fire Management Program through strategic planning and coordination by providing consultation and expertise in wildland fire management to national, regional, and park management. FMLB is comprised of regional fire management officers and the Branch of Wildland Fire chief and program leads. They have developed this plan to aid the NPS in wildland fire management planning and execution. Additionally, The National Cohesive Wildland Fire Management Strategy is a primary focus of this Plan. The Cohesive Strategy is a nationwide strategic plan that will help protect communities and natural resources, and most importantly, the lives of firefighters and the public. It is a long-term commitment based on cooperation and communication among federal agencies, states, local governments, tribes and interested publics. See the full plan here.

7. Visitor Experience Protection Plan 2008-2019

Understanding relationships between people and parks is critical for protecting resources unimpaired and providing for public enjoyment. The objectives of the Social Science Program (SSP) are to conduct and promote state-of-the-art social science related to the mission of the National Park Service (NPS) and to deliver usable scientific information to park managers and the public. This includes several major activities.

Socioeconomic Technical Support:

- Offers parks and programs guidance concerning requests for technical assistance, identifying and prioritizing social science needs.
- Provides socioeconomic support on required economic analyses, visitor studies, peer review processes, and other types of discipline-specific projects.

Socioeconomic Project Management:

- Acquires and implements various data collection efforts (e.g., surveys) for parks and programs to understand visitor demographics, trip characteristics, opinions about park services and facilities, etc.
- Outlines a variety of choices for customers (park and program managers) to acquire research through external subject matter experts (e.g., cooperators and contractors).

Economic Analyses:

- Estimates the economic contribution of NPS visitor spending as it cycles through park-level, state-, and national-level economies (Visitor Spending Effects).
- Quantifies economic value received from a variety of ecosystem services managed by the NPS.
- Conducts and ensures Service-wide consistency for required economic analyses associated with regulatory rulemaking, environmental compliance, and damage assessments.

Information Collections Review:

- Manages information collection process by assisting parks and programs with

Paperwork Reduction Act requirements for all social science surveys and information collection requests submitted to the Office of Management and Budget (OMB) for approval.

- Provides training and technical assistance to agency personnel in the development and clearance of social science survey submissions and all aspects of the PRA submission process.

Examples of Social Science research that inform human resource use, visitor experience protection within the Denali BR can be found here.

8. Vehicle Management Plan 2014

The Denali Park/BR Road is the only road that winds into the six-million-acre wilderness landscape of Denali BR. It is a portal, through which over one hundred thousand people travel each year to discover the wonders of this wild place. With visitation steadily growing, the park is approaching the core season vehicle limit of 10,512 set by park managers in the 1986 General Management Plan. Whereas the vehicle limit is clearly measureable, it is less clear that a numerical limit alone is enough to adequately protect park resources and provide for a high quality visitor experience. Other factors come into play, such as visitor perceptions of crowding at wildlife stops and rest stops; interactions between busses and wildlife; and wildlife movements in the Park Road corridor. This plan will guide management decisions regarding all vehicle use on the Denali BR/Park Road for the next twenty years. A key aspect of the new plan is the change from a seasonal to a daily limit for all vehicles (buses, National Park Service and BR staff, contractors, etc.) traveling on the controlled portion of the park road. Under the new plan no more than 160 vehicles will be allowed beyond the Savage River Check Station each day. Previously, only buses had daily limits. The Denali BR will manage vehicle behavior, timing, and numbers to meet the desired conditions and indicators identified in the plan. Visitors consistently rate wildlife viewing, one of the key indicators identified in the plan, as a major reason for visiting the park. BR managers will monitor this and other indicators to determine the appropriate level of bus and other vehicle use.

9. DOI BLM East Alaska Resource Management Plan

On March 18, 2003, the Bureau of Land Management (BLM) issued a Notice of Intent in the Federal Register to prepare a Resource Management Plan (RMP) and associated Environmental Impact Statement (EIS) for public lands administered by the Glennallen Field Office. As defined by the Federal Land Policy and Management Act (FLPMA) of 1976, as amended, public lands are those federally-owned lands and interests in lands (e.g., federally-owned mineral estate) that are administered by the Secretary of the Interior, specifically through the BLM. The RMP/EIS also fulfills the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended, to disclose and address environmental impacts of proposed major Federal actions through a process that includes public participation and cooperation with other agencies. The BLM is coordinating closely with the State of Alaska and with Ahtna and Chugach Native Corporations, as well as with all village councils located within or affected by actions occurring within the planning area. In addition, the BLM has coordinated with Wrangell-St. Elias National Park and Preserve, Chugach National Forest, Copper Valley Economic Development Council (there is no local government in the Copper Valley), and U.S. Fish and Wildlife Service in preparation of this document.

The planning area extends from the southern slopes of the Alaska Range to the Chugach Mountains, from the Talkeetna Mountains to the Wrangell Mountains, and includes an extensive area of coastline in Prince William Sound. The area is bisected by the Glenn, Richardson and Denali Highways, and is accessible by Alaska standards. The area is also bisected by the Trans-Alaska Pipeline, which runs north to south and roughly parallels the Richardson Highway. Located at the core of the planning area, the Copper River Basin is very rural in nature, with small communities and villages scattered throughout the area.

The 2000 Census reported a population of 3,120 in the Copper River Basin. The larger communities of Cordova and Valdez are within the planning area on Prince William Sound. Cordova is located near the mouth of the Copper River. Residents of the cities of Anchorage, Palmer, Wasilla, and Fairbanks utilize the area heavily for recreation as well as for sport and subsistence hunting and fishing.

Issue identification was the first step of the BLM planning, which is entirely a process of public scoping. A planning issue is a major concern, controversy, or dispute regarding management of resources or uses on the public lands that could be addressed in a variety of ways. During scoping, the BLM asked the public to provide issues or concerns to be considered in development of the RMP. Analysis of the comments was completed and a Scoping Report was finalized in June 2003. After consideration of public responses, seven major issues were formulated: Access, Lands and Realty, Vegetation Management, Subsistence Use and Rights, Natural Resources, Cultural Resources, Recreation, and Travel Management. These issues drove the formulation of the all plan actionable goals.

10. Denali Borough Land Management Plan

The Denali Borough Land Management Plan is part of a larger Denali Borough Comprehensive Plan that encompasses Economic, Social, Land Management, Resources, and Community Health issues in Denali Borough. Adopted in January 2009, it was recently amended in September 2015 under the auspice of Mayor Clay Walker. The Denali Borough, formed in 1990, is near the geographic center of the state of Alaska. The Denali Borough offices are located in Healy. The Denali Borough is the gateway to Denali National Park and Preserve, located between the Matanuska-Susitna Borough and the Fairbanks North Star Borough. The George Parks Highway and the Alaska Railroad unite the Denali Borough with Anchorage and Fairbanks.

The Denali Borough encompasses federal, state, private, Native, and Borough lands. This plan outlines six goals for land management in Denali:

Goal 1 - Ensure that the Denali Borough 'Bill of Rights' guides land use regulation functions to protect private real property rights.

Goal 2 - Maintain and update the Denali Borough Base Map.

Goal 3 - Develop a more comprehensive Denali Borough Land Use Plan with input from public and private stakeholders.

Goal 4 - Ensure that each community can retain its individual identity and develop services to support their particular requirements.

Goal 5 - Further develop the Denali Borough's platting and subdivision ordinances.

Goal 6 - Develop a method for tracking recordable land transactions within the Denali Borough.

11. State of Alaska Department of Natural Resources Land Management Plan

When Alaska became a state in 1959, it was granted more than 100 million acres of land. At statehood, the Alaska Legislature charged the Department of Natural Resources (DNR) with the complex job of managing the state-owned lands for the "maximum public benefit." DNR's goal is to contribute to Alaska's economic health and quality of life by protecting and maintaining the state's resources, and encouraging wise development of these resources by making them available for public use.There is a wide range of possibilities for how state land could be used; however, not all desired uses of state lands can occur compatibly in the same place at the same time. Wherever possible, DNR establishes guidelines that allow for multiple use. Through resource planning, DNR works with the public to determine how the land can be used for the maximum public benefit. When DNR developed the Tanana Basin Area Plan (TBAP) in 1991, which applies to state land within the study area, the goal of the planning process was to ensure that all resources were considered and evaluated. Within the study

area, the land in State ownership (land not privately owned) essentially extends from the George Parks Highway to the Sushana River. All of the state land (including the beds of navigable waters and public water bodies) in the corridor west of the Panguingue Creek subdivision is managed by DNR and is included in Subregion 4E in TBAP. The plan directs that the state lands in that unit be retained in public ownership with public recreation and wildlife habitat as the primary surface uses:

General. State land in this unit is to be retained in public ownership for multiple use management. The emphasis is on managing recreation and maintaining fish and wildlife habitat. All state land in this unit is open to mineral entry.

Fish and Wildlife. Fish and wildlife habitat is designated a primary use in subunit 4E1 (area west of Panguingue Creek subdivision). The western half of this subunit is extremely high value habitat as a calving and winter range for the McKinley caribou herd. The remaining area is prime-rated habitat for caribou, moose, grizzly bear, and furbearers. Other important activities are big game hunting, trapping, and wildlife viewing.

Minerals. The area between Dry Creek and the Teklanika River has potential for coal bearing formations. Proximity to Denali National Park may inhibit mineral development; however, mineral entry, coal prospecting, and leasing will be allowed.

Recreation. Recreation is designated a primary use in this unit. Important recreation sites include Eight Mile Lake and Stampede Road Historic Trail. Activities include backpacking, camping, and hunting.

12. Vital Signs Monitoring Plan

Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve have been organized into the Central Alaska Network (CAKN) for the purposes of carrying out ecological monitoring activities under the National Park Services' Vital Signs Monitoring program. The broad goals of the CAKN monitoring program are to: (1) better understand the dynamic nature and condition of park ecosystems; and (2) provide reference points for comparisons with other, altered environments. The focus of the CAKN program will be to monitor ecosystems in order to detect change in ecological components and in the relationships among the components. Water quality monitoring is fully integrated within the CAKN monitoring program. A monitoring program for lentic (non-moving water) has been determined, and the program for lotic systems (moving water) is under development. The CAKN has developed conceptual models to guide the development of the monitoring program. These models nest within one or more of more components of the model, which then provide a unifying framework for integrated, interdisciplinary monitoring. There are 36 identified Vital Signs for the CAKN, which represent a systems-based approach to monitoring, and these are presented within the Vital Signs Framework as developed by the National Park Service Vital Signs Monitoring program. Three vital signs refer to air and climate, two refer to geology and soils, four refer to water, four refer to human use, five refer to ecosystem pattern and processes, and 18 refer to biological integrity. Prompt data analysis and reporting are central tenets for the CAKN. The network will provide sufficient funding for these activities to ensure that by March each year the previous phenological year (Oct.–Sept.) is reported on. An annual integrated "State of the Parks" report is also a main component for the reporting of the program. Individuals responsible for data analysis and reporting for each Vital Sign are identified.

The network has developed a three-year plan for administration and implementation of the monitoring program. This plan includes: a staffing plan, how network operations are integrated with other park operations, key partnerships, how in-house field work will be carried out, and the periodic review process for the program. The network relies strongly on existing park personnel as principal investigators for each Vital Sign. Key partnerships include the U.S. Geological

Survey Biological Resource Division, the Western Regional Climate Center, the U.S. Department of Agriculture Natural Resources Conservation Service, the Alaska Bird Observatory, and the University of Alaska Fairbanks Institute of Arctic Biology.

13. Education Plan

The Denali Education Plan is a broad-scoped vision for the development of an exemplary education program at Denali National Park and Preserve. The overall purpose of the Plan is to communicate the park's long-term vision, key interpretive themes, educational priorities and strategies to three primary audiences, each of which has a vital role in the future of education at Denali. These audiences are the Denali National Park and Preserve staff; Alaska regional NPS staff; and a full array of the park's current and potential educational partners, including Alaska State Parks and communities beyond park boundaries. Here, the term education includes both traditional interpretive services and non-traditional curriculum-based approaches. The Plan also covers community outreach, training, evaluation, and the critical role of relationship building with partners offering a growing suite of programs to audiences within and beyond park boundaries. Functionally, the Plan is meant to help direct and focus all efforts related to interpretive and educational services at the park in the following ways:

- Coordinate and integrate future educational program development within the framework of a vision and strategies shared by all park staff, partners, and local communities and Denali State Park.

- Enable park management to evaluate the performance of the park's Center for Resources Science and Learning (CRSL) out of which are derived education initiatives and future partnerships.

- Fully realize the potential of the Murie Science and Learning Center (MSLC).

- Strengthen and clarify roles and relationships of the park's educational partners.

- Serve as a foundation for an expanding base of leveraged outside resources.

14. Bear-Human Conflict Management Plan

The Denali BR provides a valuable opportunity for the public to foster an appreciation and understanding of bears. This appreciation and public support could enhance efforts to conserve threatened bear populations in other areas. However, as visitor use in Denali continues to rise, the potential for conflict between bears and people is a major concern (BMP 2003). Particularly, availability of human food and garbage at campsites, campgrounds, and other areas of human use may attract both black and grizzly bears. Habituation of bears to people by food rewards is the primary factor associated with bear-human conflicts in national parks (Albert and Bowyer 1991). Although no human fatalities have occurred in the park and injuries are few, the number of bear-human incidents and encounters is high. The factors affecting bear-human conflicts must be actively managed and the effects of Management actions must be investigated. The continued experimental development and adaptive management implementation of a bear-human conflict management program, by professional biologists and highly trained technicians, is essential to visitor safety and resource protection.

The purpose of the Bear-Human Conflict Management Plan (BMP) is to provide general guidelines that minimize bear-human conflict in Denali. The goals of the BMP are based on policies of the National Park Service (NPS) and legislation specific to Denali BR. The goals for bear-human conflict management are to:

1. Provide visitor safety by minimizing bear-human conflicts,

2. Minimize the effects of visitation on the distribution, abundance and behavior of black (*Ursus americanus*) and brown

(*Ursus arctos*) bear populations by minimizing bear-human conflicts,

3. Ensure opportunities for visitors to observe, understand, and appreciate black and brown bears, as a part of an intact ecosystem, and

4. Achieve these goals with a minimum of intrusive management actions.

The implementation of the Bear-Human Conflict Management Program will follow three courses of action and their corresponding program elements: education, removal of unnatural food sources, and management actions in response to bear-human interactions.

B. Environmental Assessments

The National Environmental Policy Act (NEPA) is landmark environmental protection legislation establishing as a goal for federal decision-making a balance between use and preservation of natural and cultural resources. NEPA requires all federal agencies to: (1) prepare in-depth studies of the impacts of and alternatives to proposed major federal actions; (2) use the information contained in such studies in deciding whether to proceeds with the actions; and (3) diligently attempt to involve the interested and affected public before any decision affecting the environment is made. This is the NEPA portal for the United States, and Denali BR, respectively: https://ceq.doe.gov/ and https://www.nps.gov/dena/getinvolved/planning-nepa.htm

Under the National Environmental An Environmental Assessment (EA) is a planning tool that is used to explore alternatives and determine whether those alternatives will have significant impacts. EAs are made available to the public for review and comment. If the EA reveals that the proposed action will have a significant impact, an Environmental Impact Statement (EIS) must be prepared (see next section). If the EA reveals that there will not be significant impacts, a decision document is prepared and signed (see below, and here for EA example in Denali BR).

C. Environmental Impact Statements

NEPA requires the preparation of an EIS whenever park management proposes an action whose impacts on the natural and/or human environment may be significant. An EIS will include a range of alternatives that will be evaluated for potential impacts. EISs are made available for public review and comment. Park managers may proceed with a decision document (see below) following the public review process.

If an EA reveals that there will be no significant impacts, a preferred alternative is selected, and a Finding of No Significant Impact (FONSI) will be prepared. A FONSI is an explanation of why the selected action will have no significant effects on the natural or human environment. It is based on the EA and the comments of agencies and the public. The FONSI is signed by the Regional Director of the National Park Service.

At the conclusion of an EIS, a Record of Decision (ROD) must be signed. The ROD describes the ultimate choice of an alternative, mitigation measures to reduce impacts, and the decision rationale. The ROD is signed by the Regional Director of the National Park Service. Examples of an EIS, FONSI and ROD in the Denali BR are located here: https://www.nps.gov/dena/getinvolved/planning-nepa.htm

D. Development Concept Plans

A Development Concept Plan (DCP) is used for larger development proposals within the park (i.e., a new visitor center), or where planning for the future of the park encompasses a large area. A DCP explores alternatives and lays out a conceptual framework for park managers to follow in the future. DCPs frequently include an EA so that the impacts of the alternative concepts can be evaluated. DCPs are made available for public review and comment. (Learn more from the source: http://www.nps.gov/dena/learn/management/planning_documents.htm)

2.3.2 Budget and staff support, including approximate average annual amounts (or range from year-to-year); main sources of funds (including financial partnerships established (private/public), innovative financial schemes); special capital funds (if applicable); number of full and/or part-time staff; in-kind contribution of staff; volunteer contributions of time or other support.

The budget varies from year to year based on a portion of the funding that is competitive with other NPS areas. Overall the BR is well funded with a mix of appropriated funds provided by Congress, and revenue generated within the BR through concession franchise fees, special-use fees, and entrance fees. Volunteer labor adds significant capacity. However, funding has remained somewhat static despite increased visitation and challenges associated with climate change. The budget in the table below reflects approximation of current numbers. The sources of funding come in three major categories: Base, appropriated, money provided by congress: about $12 million; concession franchise fees: about $3 million; recreation / entrance fees: about $2.5 million; Federal Highways funding $3 million.

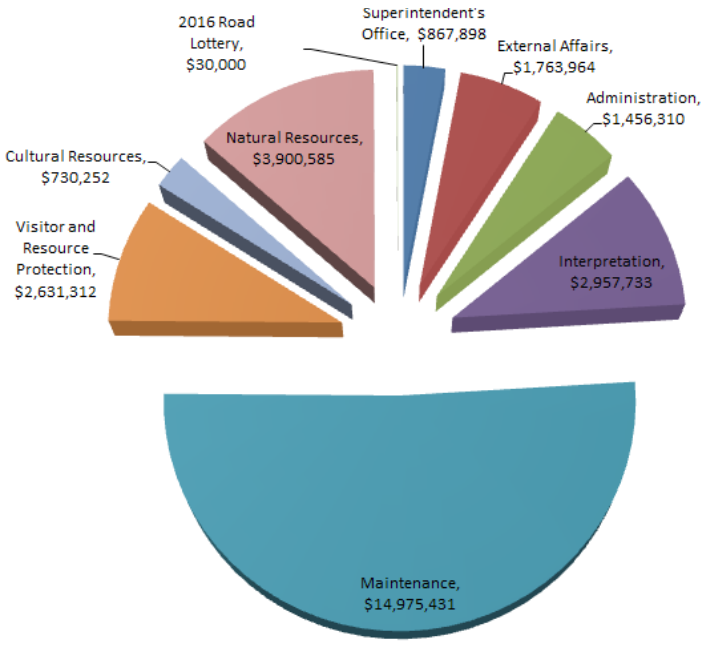


Figure 2.3.2. Detail of budget expense categories.

Table 2.3.2 Annual Activity and Expense Report Denali Biosphere/Park and Preserve

Report Date: Sept. 2015	
Volunteer Coordinator and Park Information:	
Total Volunteers	**483**
Total Hours	**56,140**
Volunteer hours by category:	
Administration	1,902
Campground Host	4,060
Cultural Resource Management	733
General Management	6,022
Interpretation	16,194
Maintenance	9,134
Natural Resource Management	7,942
Protection/Law Enforcement/Visitor and Resource Protection	10,153

NPS/TIM RAINS



Working with sled-dog puppies is a favorite volunteer position.

Volunteer Program Highlight:
The School-to-Work Program, a cooperative between Denali BR and the Tri-Valley School District, continued into its 16th year. To date, high school students have built 32 cabins which have replaced dilapidated seasonal housing cabins.

Mountaineering volunteers, 43 of them this year, donated more than 12,000 hours, each spending 30 consecutive days on Denali's base camps at 14,000 and 17,000 feet assisting climbers, participating in searches and rescues and providing medical assistance.

More than 90 volunteers walked and cared for the 30 dogs, and eight puppies that were born in the spring, in the historic kennels.

Other volunteer information:

Number of interns: 18

Intern Hours: 12,805

Number of Artists in Parks: 7

Artist-in-Parks Hours: 1,678

Number of International VIP: 12

International volunteer Hours: 1,713

Number of Boy Scouts: 23

Boy Scout Hours: 280

Number of Girl Scouts: 10

Girl Scout Hours: 15

2.3.3 Communications strategy for the biosphere reserve including different approaches and tools geared towards the community and/or towards soliciting outside support.

The BR does not yet have a stand-alone communication strategy; however over the next decade Denali National Park staff will develop a set of communication venues. Importantly, the national park's, robust and active, internal and external communication methods are comprehensive and include:

1. Denali has a robust and informative park website at www.nps.gov/dena and a thriving outreach presence on five popular social media platforms—including Twitter, Facebook, Flickr, YouTube, iNaturalist, Map of Life, and Instagram—to strengthen public connections to park resources, and

to encourage visitors to engage in citizen science (wildlife and plant sightings) and share experiences of the park with each other. Map of Life, and iNaturalist are applications visitors are encouraged to use, and load their sightings and experience online, but these are not monitored or directed by Denali BR. Links to the five social media outreach sites we now actively maintain include:

twitter.com/DenaliNPS

www.facebook.com/DenaliNPS

www.flickr.com/photos/DenaliNPS

www.youtube.com/USer/DenaliNPS

https://www.instagram.com/DenaliNPS/

One example: DenaliNPS is a Facebook fan page established by the National Park Service in November 2010 as an interpretive outreach forum to strengthen public connections to park resources, and to encourage local residents, visitors to share experiences of the park with each other.

2. Denali has a Plant Identifier, and other smart device apps visitors and the wider public can download and use while in the park to identify plants, animals, and landscape attributes, and share experiences with park staff, their friends and family and general community. Moreover, these apps engage visitors to become citizen scientists and improve the general awareness and management of the Denali Biosphere.

3. An information office to provide immediate customer service.

4. A public information office that actively engages internally with staff as well as externally with a metropolitan media market and frequent national interests.

5. A public media specialist to engage full time with the media through video, audio, print, and all the media above.

Coordination with our Areas of Partnership and Cooperation is often accomplished through joint press releases, shared communications opportunities, shared community public space, and shared publications.

2.3.4 Strategies for fostering networks of cooperation in the biosphere reserve that serve as connections ("bridging") among diverse groups in different sectors of the community (e.g., groups devoted to agricultural issues, local economic development, tourism, conservation of ecosystems, research and monitoring).

The BR engages with diverse sectors of the local population as well as its yearly visitors via targeted stakeholder meetings, educational programs through the Murie Science and Learning Center, through the varied programs and support from the BR's partner: Alaska Geographic, and through the Denali Education Center. The Denali Education Center is integral to the communities of the BR along the Parks Highway (e.g., Cantwell, Healy, Denali Park) providing training, jobs, outreach, scholarships and space for creative development among the different demographic cohorts of the BR communities. Alaska Geographic and the Murie Center extend to both the local communities and to the wider Alaska region, pulling in underprivileged youth from urban areas or more remote, isolated communities for service learning programs within the BR. One highlight is the 5th grade science school. A 2.5-day residential program for students from around the state that focus on science literacy and permafrost. Another highlight is the BR works closely with the local school's building trade program. The BR funds the acquisition of building materials and local students learn how to build cabins that are used to house the seasonal workforce. Alaska Geographic also provides scholarships and together with the Murie Center, highlight traditional ecological knowledge and culture of the BR's Athabascan communities. This produces a network of cooperation with the Zone of Cooperation and Partnership.

2.3.1 and Section 7 further describe the planning processes that address these

NPS



Athabascan people of Nikolai craft shoes that capture the essence of Denali's tundra rose.

community connections and bridging strategies of the BR.

2.3.5 Particular vision and approaches adopted for addressing the socio- cultural context and role of the biosphere reserve (e.g., promotion of local heritage resources, history, cultural and cross-cultural learning opportunities; cooperation with local population; reaching out to recent immigrant groups, indigenous people, etc.).

The particular vision of the BR of incorporating socio-cultural context, history and cultural resources is summed in the aforementioned Foundation Statement, the General Management Plan, and the Resource Stewardship Strategies. These strategies mandate specific, realistic processes that produce resources protection measures, materials, and education opportunities related to:

1. Local heritage (e.g., oral history projects)

2. Cultural learning opportunities (e.g., distance learning courses for primary school children through the Murie Center for Science and Learning; internships in cultural resources and museum collections)

3. Cooperation with local population (e.g., access to BR for subsistence harvest, community open forum meetings for proposed management strategies of the BR, open public comment for projects or other changes within the BR core, managed use area, and transition zone).

4. Reaching out to indigenous people (e.g., support the Athabascan communities' way of life, preserve and protect from mining, harvesting, or other extractive industries that would harm the BR managed use and transition zones, support the Athabascan culture via oral histories, educational programs and engagement with wider community and visitors).

5. Reaching out to immigrant groups. For example, advertise BR internships and other employment opportunities to all segments of the U.S. national or U.S. permanent resident population. Also we provide educational outreach materials for backpacking and travel in the Biosphere Region in Spanish, Japanese, German, and French among other languages to visitors. Additionally, some of the BR staff (Interpretation rangers) supplement their talks, guided hikes or tours in other languages and American sign language as needed.

2.3.6 Use of traditional and local knowledge in the management of the biosphere reserve.

The Denali Subsistence Resources Commission (SRC) is composed of residents of local communities, within the Zone of Cooperation and Partnership, where subsistence (hunting, fishing, and gathering) are a significant source food for the communities. Many of these villages are not on the road system and have a long demonstrated tradition of subsisting off of locally available resources. Membership is determined by village council nominating people with the US government nominating one local resident that is not a government employee. The SRC is authorized under US law to "advise" National Park Service

mangers on subsistence issues. This advisory group brings traditional ecological knowledge directly to managers, and into the subsistence resource management regulations that are tied to subsistence resources on which these local communities depend. The SRC has also inspired park managers to put on culture camps, and fund the native place names project described below in section 2.3.7. Sections 2.3.1, 2.3.8 and section 4 describe additional information on the planning processes and strategies that relate to traditional knowledge.

2.3.7 Community cultural development initiatives. Programmes and actions to promote community language, and, both tangible and intangible cultural heritage. Are spiritual and cultural values and customary practices promoted and transmitted?

The native place names project is an important step in documenting traditional knowledge and reconciling the impacts of colonial practices. In 2015, the tallest mountain peak in North America (which happened to be in the BR's Core Protected Area) was un- renamed to Denali! The local Athabascan name for the mountain is Denali. However it was named Mt. McKinley by Euro-American prospectors. There are many other geographic features in the region were named by indigenous Alaskan but bare Euro-American names. The NPS in partnership with local village council members have been working on getting Indigenous nomenclature into a GIS and onto maps. These names and their geographic tell us much about how traditional people thought about and used the landscape. These sites are also targeted for archeological surveys. In 2017 Denali's brochure map will feature a set of these names. Please see sections 2.3.1 and sections 4 and 7 for additional information on the planning processes and strategies that address these.

2.3.8 Specify the number of spoken and written languages (including ethnic, minority and endangered languages) in the biosphere reserve. Has there been a change in the number of spoken and written languages? Has there been a revitalization programme for endangered languages?

English is the only stable language in the BR. A few elderly native speakers of the local

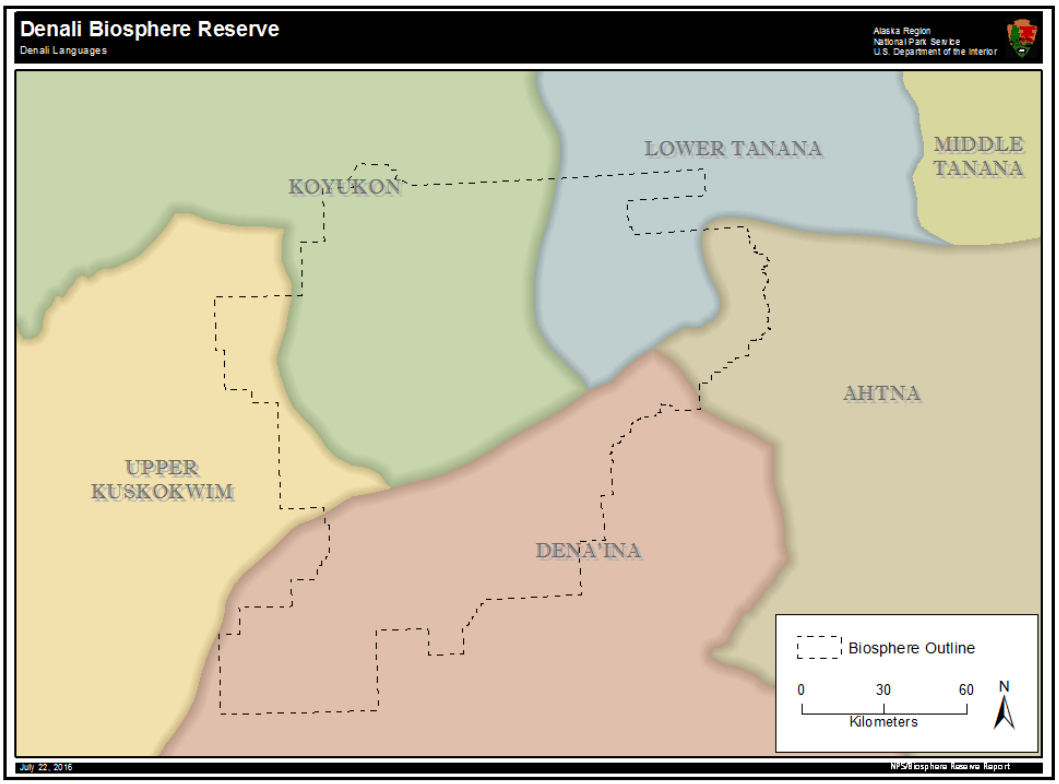


Figure 2.3.8 Denali Biosphere Reserve Athabascan Languages

Athabaskan dialects still remain living in the BR. Russian had historical influence in some of the Athabascan dialects spoken around Nikoli, a Russian orthodox community. While English is the lingua franca, there are five small, declining Athabascan dialects used in the BR managed use area and transition zone (see Figure 2.3.8, below). Five Athapaskan language geographic extents have had some territory in the river drainages that surround Denali National Park and Preserve: Ahtna to the east, Dena'ina) to the south, Upper Kuskokwim to the west, Koyukon to the north, and Lower Tanana to the northeast. The most prominent dialect spoken is Upper Kuskokwim in the villages of Nikolai, Telida, and McGrath. In 2008 the University of Alaska-Fairbanks, Alaska Native Language Center conducted a linguistic survey throughout the Upper Kuskokwim Region. Results found there were thirty Upper Kuskokwim Athabaskan (UKA) first language speakers and twenty seven second language speakers. In the eight years since the survey was conducted many fluent speakers have passed away. To date there are ten UKA first language speakers, and fifteen who speak UKA as a second language. At this time UKA is not a lost language, but it is moribund and may be gone within the next generation. There have been attempts in recent years to revitalize endangered languages within the subsistence communities of the BR. Importantly, the BR maintains the vitality of these languages through preserving the vitality of traditional livelihoods and culture via access and rights to use and be part of the intact BR ecosystem. Some support for cultural preservation and linguistic sovereignty comes from tourism. Since 2008, several levels of documentation and preservation efforts have been carried out. One of the major thrusts to preserve the language has been the BR partnership with Nikolia Edzeno' and Telida Tribal Councils to collect and document subsistence stories, travel narratives and traditional place names. As part of Denali's Centennial, with guidance from the surrounding tribal councils, Denali BR managers will add ten to fifteen Athabaskan place names to its visitor map. BR and Park lands and associated place name resources hold key linguistic elements in maintaining Athabaskan traditional connections to sacred sites, cultural resources and traditional lifeways ways of life. These Athabaskan names are rich ethnographic, linguistic, and historical resources. The names were preserved in oral tradition and have been replaced with English names on modern maps. Many of the elders who knew the place names and their stories are now gone; the urgency with which the BR and partners document the knowledge of those still living cannot be understated. The 2015 announcement that Mt. McKinley would finally be renamed Denali is an example of a broad effort to bring back indigenous names of landmarks and places. The restoration of Denali as the official place name of the National Park and Biosphere, is a sign of recognition and respect for Athabascan and other Alaska Native languages and traditions. Denali is Alaska's most visible mountain and most prominent place name. The Denali name change will enhance awareness of the concept of indigenous geographic knowledge in the BR visitors, and general public. It introduces to the public basic concepts such as official place names, Native-origin place names (Denali), and authentic Native language names (such as Koyukon Deenaalee).

2.3.9 Management effectiveness. Obstacles encountered in the management/ coordination of the biosphere reserve or challenges to its effective functioning.

Challenges: Overall trend in disestablishmentarianism. BR staff turnover and community resistance to perceived limits on hunting/access/use of BR zones. This local resistance has been in place since the passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980. Recently, as local residents experience the economic and lifestyle benefits, local support has grown.

Economic challenges: The primacy of tourism as local economic driver. The economy is based on visitor numbers and spending. The challenge of balancing community and the travel industry's goals with impacts to wildlife, cultural resources, and visitor experience.

The Vehicle Management Plan and the Backcountry ManagementPlan address this challenge through an indicator and standards approach to capacity management.

2.4 Comment on the following matters of special interest in regard to this biosphere reserve (Refer to other sections below where appropriate).

2.4.1 Is the biosphere reserve addressed specifically in any local, regional or/and national development plan? If so, what plan(s)? Briefly describe such plans that have been completed or revised in the past 10 years.

The BR is specifically addressed in the National Park Service, Denali National Park general management plans, resource strategies, backcountry management plan. By extension, the BR is part of any regional and national development plan that is under the National Park Service and Department of the Interior planning framework. The NPS has not been a strong part of local community development plans regarding tourism and recreation sector development. However, with this re-invigorated BR we plan to inspire and be part of future planning efforts regarding sustainable development and land use.

2.4.2 Outcomes of management/ cooperation plans of government agencies and other organizations in the biosphere reserve.

The BR has numerous examples of coordinated wildlife research and management, geohazard monitoring and management, physical and air quality resources management and restoration of plant communities as described in sections 3 and 7. The BR often advises other local, national, and international agencies on approaches to protected area management.

2.4.3 Continued involvement of local people in the work of the biosphere reserve. Which communities, groups, etc. How are they involved?

In addition to the general public participation in decisions, we have a diverse set stakeholder groups who are contacted/informed, invited to engage in significant management issues/ decisions and include:

Nikolia Edzeno Council
Telida Council
Ingalik Council
Tanana Council
Association for Responsible Development
Alaska Conservation Foundation
Alaska Geographic Field Institute
Alaska Department of Fish and Game
Alaska Parks and Recreation
Alaska Department of Natural Resources
Alaska House
Alaska Senate
Alaska State Historic Preservation Office
Audubon Society
Bureau of Land Management
City of Healy
City of Cantwell
City of Anderson
Denali Borough
Defenders of Wildlife
Tri-Valley School
Denali Citizens Council
Denali Education Center
Environmental Protection Agency
Federal Aviation Authority
Healy Chamber of Commerce
Mat-Su Borough
National Federation of the Blind
Northern Environmental Center
National Parks and Conservation Association
Office of Representative Don Young
Office of Senator Lisa Murkowski
Office of Senator Dan Sullivan
State of Alaska
Sierra Club Alaska Chapter
Koyokuk Council
The National Organization on Disability
The Wilderness Society
University of Alaska Fairbanks
University of Alaska Anchorage
U.S. Army Corps of Engineers
U.S. Forest Service
U.S. Fish and Wildlife Service
U.S. Department of Agriculture Natural Resource Conservation Service

2.4.4 Women's roles. Do women participate in community organizations and decision-making processes? Are their interests and needs given equal consideration within the biosphere reserve? What incentives or programmes are in place to encourage their representation and participation? (e.g., was a "gender impact assessment" carried out?) Are there any studies that examine a) whether men and women have different access to and control over sources of income and b) which sources of income do women control? If so, provide reference of these studies and/or a paper copy in an annex.

The Denali BR is subject to the anti-sex discrimination laws of the US, and these are strictly enforced. The Denali BR staff, both seasonal and permanent, are given equal opportunities for employment; consequently the composition of male and female employees are balanced, though more women are employed than men overall. Women are well represented in the monitoring and management of the Denali BR, most of the science and research staff of the BR are women, and many division heads of the National Park Service are women, who are the primary agents in the management and decision-making process. Across North America women are found in senior leadership positions despite the persistent wage differentials between women and men and the "glass-ceiling" effect. Given a higher average level of education for women in the U.S., women generally have the same access to resources and income as do men, though some economic sectors remain gendered. There is no such assessment associated with the periodic review for this Biosphere Region, because gender impact statements are rarely demanded. However, social science studies in the BR stratify samples by gender (and race) because we are interested in determining where primary benefits of the tourism industry accrue.

Gender distinction does not bear on the establishment of partnerships in the Biosphere Region. The interests and needs of women are given equal consideration within this Biosphere Region. Unique to the Denali BR, is the primacy of women-dominated and owned enterprises related to tourism (lodges, guided tours, restaurants). Due to the thorough participation of women in the Biosphere Region's collaborating organizations, the Biosphere Region does not need, and therefore does not conduct, specific programs addressed solely to meeting the needs of women.

2.4.5 Are there any changes in the main protection regime of the core area(s) and of the buffer zone(s)?

In 1980, the passage of the Alaska National Interest Lands Conservation Act (ANILCA) enhanced the BR core zone by designation it as Wilderness, as well as creating the BR managed use area and transition zones. This significant legislation significantly enhances the control of BR staff in effectively managing the zones.

2.4.6 What research and monitoring activities have been undertaken in the biosphere reserve by local universities, government agencies, stakeholders and/or linked with national and international programs?

The ecosystem attributes currently receiving inventory and monitoring follow the conceptual model of ecosystem drives and components developed at the program inception. Attention focus on ecosystem drivers, such as climate and water (quality, quantity, distribution), along with key components of each trophic levels including:

Abiotic ecosystem drivers:

1. Climate monitored since 1924
2. Snowpack monitored since 2006
3. Streams and rivers monitored since 2009
4. Shallow lakes monitored decay since 2003

5. Permafrost dynamics monitored since 1984

6. Glacier dynamics monitored since 1991

7. Air quality and atmospheric chemistry monitored since 1980

Biotic Components:

- Vegetation structure and composition monitored since 2006
- Small mammals monitored since 1991
- Caribou population dynamics monitored since 1986
- Dall's Sheep population dynamics monitored since 2007; historical data exists
- Moose population dynamics monitored about every three years since 1991
- Passerine birds monitored since 1994
- Golden eagle population and migratory dynamics monitored since 1986
- Wolf population dynamics monitored since 1986

Visitor experience:

- Soundscapes - acoustic resources monitored since 2003
- Scenic resources – scenic landscapes (viewsheds) along park road monitored since 2004 as part of managing traffic along the park road
- Wilderness character - landscape modifications, human access, ability to find solitude, administrative presence, and evidence of modern humans monitored since 1980
- Visitor experience - recreation, learning, and opportunities to connect with nature in the biosphere, monitored every five years since 2006; historical data exist

Cultural Resources

- Archeological Surveys
- Historic Preservation
- Recording, documenting Alaska Native traditions and culture
- Preserve indigenous languages

Engage with Native communities in the BR and Alaska-wide

2.4.8. Please provide some additional information about the interaction between the three zones.

The authority for the Core and Managed Use zones is with the NPS. The NPS continually address management, law enforcement, and research concerns. The State of Alaska and the Bureau of Land Management (BLM) manages the Zone of Partnership and Cooperation. The NPS meets annually or as needed these government entities. We coordinate on common emerging issues and emergency response. Each authority has established processes to work with the public, include diverse input and perspectives, and to include these audiences in decisions. Currently the Zone of Partnership and Cooperation is not within the BR boundary. However this zone functions very effectively as a Transition Zone as outlined in the Seville Strategy. It is largely undeveloped, provides vast areas of connectivity between the Core Protected Area and other fully protected landscapes in Lake Clark National Park while providing for harvest of wildlife resources to hundreds of residents and economic opportunities for ecologically appropriate mining opportunities and guides. Over the next decade, as the relationships between the NPS, the State of Alaska, and the BLM strengthen in relation to the Denali Biosphere Region's Zone of Partnership and Cooperation, the BR's boundary may expand to encompass all

these lands and into Lake Clark National Park and Preserve.

2.4.9 Participation of young people. How were young people involved in the organizations and community decision-making processes? How were their interests and needs considered within the biosphere reserve? What are the incentives or programs in place to encourage their participation?

Youth have been engaged in science programs and culture camps to learn how to gather, interpret and present science so as to develop their skills and abilities to inform organization and community decision-making processes. These science programs include week long field courses led by BR scientists, distance learning courses, in-house (at the MSLC) seminars and hands-on learning activities. The field courses and in-house seminars are particularly popular with local community youth. Additionally, we have youth volunteers and also employees where we provide:

- Orientation providing youth an introduction and exposure to the federal government, the NPS, professional work, and organizational culture while inspiring an environmental ethic, connections to nature and healthy lifestyles. This includes: structured curriculum, classes, basic information sharing, discussions, involvement and training.
- Experience giving youth hands-on experience to learn and develop skills, apply existing knowledge and develop relationships and future opportunities. This includes: citizen science projects, service learning, classes, training, Volunteer in Parks (VIP), internship, seasonal positions and other appropriate opportunities.
- The long standing School to Work Program has invested in the local school's buildings trade curriculum. The National Park Service funds students to learn building skills and subsequently build cabins that are transported to the managed use zone and used for housing seasonal staff. The architecture of these structures confirms to local rustic style.
- The site has a local hiring program where year-round member of the local resident zone communities have an exclusive, local hire, opportunity to apply for federal employment
- A Career Path empowering individuals to understand, develop and create career pathways in public service through the development of competencies.
- Finally we engage youth in education experiences such as the Junior Ranger program, youth conservation corps, and service learning projects as described in section 6.4.



NPS/JACOB W FRANK

Ethnobotanicals are an important aspect of the Ecosystem Services of Denali Biosphere Region. Every year, lowbush cranberries thrive in the peatlands, sub-alpine areas of the Biosphere Region where people and animals still consume and preserve them for the winter months.

Section 3. Ecosystem Services

Denali provides a wealth of ecosystem services, which humans, wildlife, plants and fungi exploit to draw from, and build up, a healthy functioning ecosystem. Ecosystem services highlighted in this section include: vegetation, air quality, carbon sequestration, watershed health, pristine habitat for functioning (and increasingly rare) predator-prey systems, potential pharmaceutical elementals, and human subsistence harvesting of healthy game, plants, and fish that preserve traditional ways of life.

3.1 If possible, provide an update in the ecosystem services provided by each ecosystem of the biosphere reserve and the beneficiaries of these services.

(As per previous report and with reference to the Millennium Ecosystem Assessment Framework and The Economics of Ecosystems and Biodiversity (TEEB) Framework (http://millenniumassessment.org/en/Framework.html and http://www.teebweb.org/publications/teeb-study-reports/foundations/).

There are four major ecosystems in the BR: taiga, tundra, riparian and alpine (see Figure 3.1 for Denali BR Landcover classes, below). Each interact on the landscape to form an even larger ecological system that ranges from boreal (taiga) forest in lower elevations, tundra and alpine-tundra, and alpine, as the BR topography climbs to "the High One" (Denali). The elevational gradient ranges from 68.5 meters to 6,010.2 meters.

Provisioning services or opportunities for people to harvest resources are largely found in the taiga and tundra within the managed use area, and transition zones. Hunting for mammals and birds occurs exclusively in these areas and is prohibited in the core zone. The BR is also a potential source for genetic resources, particularly for the pharmaceuticals, thus retention of biodiversity is a direct service. The BR is the source of major glaciers and glacial rivers that serve rural communities directly (water source, food source, energy source) and by extension, urban populations beyond the BR area. Regulating services are found among all three ecosystems where protection of habitat

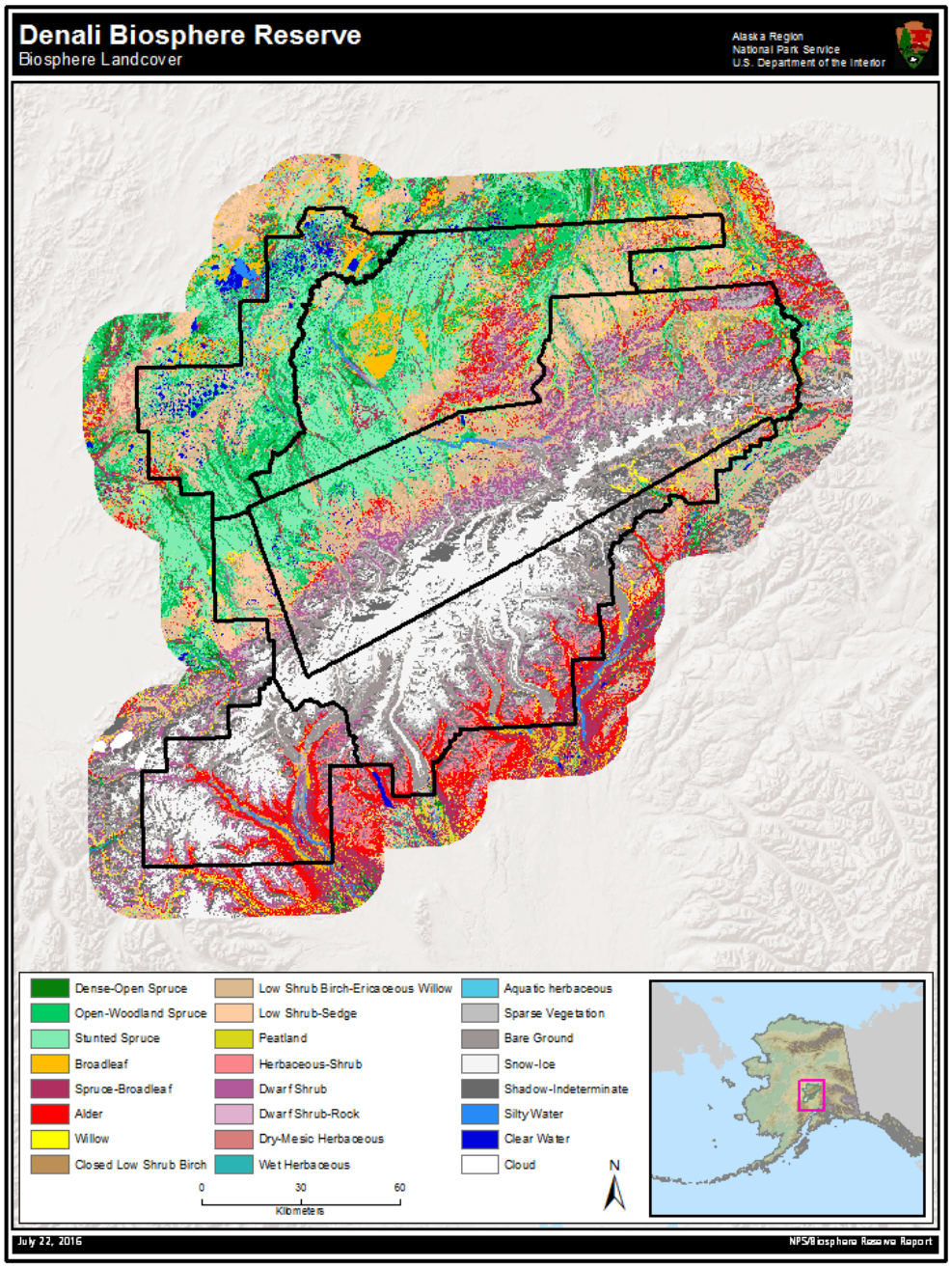


Figure 3.1 Denali Biosphere Region Land Cover.

diversity and riparian areas are a priority for maintenance of water quality and quantity.

Cultural services are significant ecosystem services in providing recreation and tourism; spiritual, aesthetic, inspirational, educational experiences; a sense of place; a cultural heritage.

Collectively the BR provides supporting services of soil formation, nutrient cycling and primary production. The BR serves as a reference site, and an example, for high functioning, intact, ecosystems and as a reference point for the climatic and terra-altering forces that disproportionately affect northern latitudes.

Specify if there are any changes regarding the indicators of ecosystem services that are being used to evaluate the three functions (conservation, development and logistic) of the biosphere reserve. If yes, which ones and give details and update.

There are no changes. For the purpose of clarity, we offer the following:

For conservation we evaluate a diversity of indicators. Please see the attachments on vital signs and the State of the Park for details (also see section 4).

For development we track tourism, economies of scale and diversification, coal mining, subsistence harvesting, and energy (documented in section 5).

For logistic we track the types and kinds of research that occurs in the park (see attached research list) as well as the interactions with people (see section 6).

3.3 Update description on biodiversity involved in the provision of ecosystems services in the biosphere reserve (e.g., species or groups of species involved).

The BR hosts a team of science staff, regional National Park Service science staff, and university researchers and consultants, the BR's biodiversity is captured in a diverse array of papers relating changing flora and fauna communities within the Denali BR. One authoritative sources on the BR's biodiversity is the NPSpecies database. This online information sources is update as new taxa are reported or described. Recently, inventories of lichens and bryophytes were completed. An arthropod inventory is underway and scheduled to be completed in 2020. In addition to these links, a list of species is available in the annex.

Species Diversity in the Park

Mammals

The Denali BR contains the full complement of small and large mammal species that were present prior to Euro-American contact. A full annotated listing of the BR's 43 mammal species is available at the NPSpecies website. The early Euro-American explores, Charles Sheldon and Belmore Brown, to visit the area were impressed with the contingent of large mammal species, and in particular the Dall's sheep. Charles Sheldon spent the decade following his initial visit lobbying congress for the creation of a national park. In 1917, Congress agreed to set aside Mt. McKinley National Park as a "game preserve" to protect the area's rich megafauna.



NPS/KENT MILLER

Grey wolf.

The park's Megafauna including wolves, brown bears, black bears, caribou, moose, and Dall's sheep co occur in a naturally regulated ecosystem. The BR continues to host one of the world's longest studies of predator prey dynamics, aspects of which were initiated in 1939 (Murie 1963). The current investigation began in 1986 with high spatial and temporal resolution tracking of wolf -caribou population cycles. This ongoing work is especially significant given the rarity of intact ecosystem in a world of 7.25 billion people. These data serve as a reference for comparison with population dynamics in more manipulated systems (Owen and Mace 2006).

NPS/KEN CONGER



Harlequin ducks.

This full complement of species occurs in the managed use area, and transition zones, although the dynamics may be slightly influenced by differences in harvest management. Harvest levels are low in the northern managed use area and transition zone, and moderate in the in the southern managed use area and transition zones. In portions of the transition zone, harvest pressure in high on some species and predator control measures are occasionally implemented to increase harvest opportunities for ungulates. However, even in light of the *intensive management* (McNay 2002) occurring in portion of the transition zone, natural regulator forces are still dominant. Human population density and development are low enough that wolves radio collared in the BR have successful dispersed through the transition zone and were detected breeding over 700 km from their natal territory (Borg and Burch 2013).

Avian Species

Adolph Murie, who worked in Denali intermittently from 1930-1939 and full time until 1950, was one of the first scientists to study and understand the ecological significance of birds in Denali. These early studies were followed by more in-depth and long-term studies by Adolph Murie extending from the late 1930s until about 1970. The valuable contributions of these scientists are published in several books. Denali's bird life is made up of migratory birds from all over the globe and a hardy group of birds that remain in the area year-round. The abundance of birds in Denali ebbs and flows across the seasons, increasing significantly as migrants return to Denali in spring and decreasing when they depart in autumn. Summer birding in Denali rewards visitors with opportunities to view many species in this spectacular northern environment. Birding in winter is slim by numbers but great in rewards, as observations of pine grosbeaks, mixed flocks of ptarmigan, or perhaps a northern goshawk or gyrfalcon await the hardy winter birder. Thirty-five species of water birds (loons, grebes, swans, and ducks) occur in Denali, and 23 species are recorded as nesting in Denali. Three species of loons (red-throated, Pacific, and common) and two species of grebes (horned and red-necked) nest in Denali. Geese are most often seen during migration and are not common breeders, except for white-fronted geese, including Tule's white-fronted geese, which nest in Denali. Over 400 pairs of trumpeter swans nest in the productive wetlands in the northwestern portion of Denali and along Denali's southern borders. Tundra swans do not nest in Denali but are commonly seen during spring and autumn migration. Twenty-three species of ducks, including 15 nesting



NPS/KENT MILLER

Golden eagle.

species, occur in Denali. Nesting species include American wigeon, mallard, northern shoveler, northern pintail, green-winged teal, greater and lesser scaup, harlequin, surf scoter, white-winged scoter, black scoter, long-tailed duck, bufflehead, Barrow's goldeneye, and red-breasted merganser. Ducks seen during migration include gadwall, Eurasian wigeon, blue-winged teal, canvasback, redhead, ring-necked, common goldeneye, and common merganser. All of the water birds that occur in Denali are migratory.

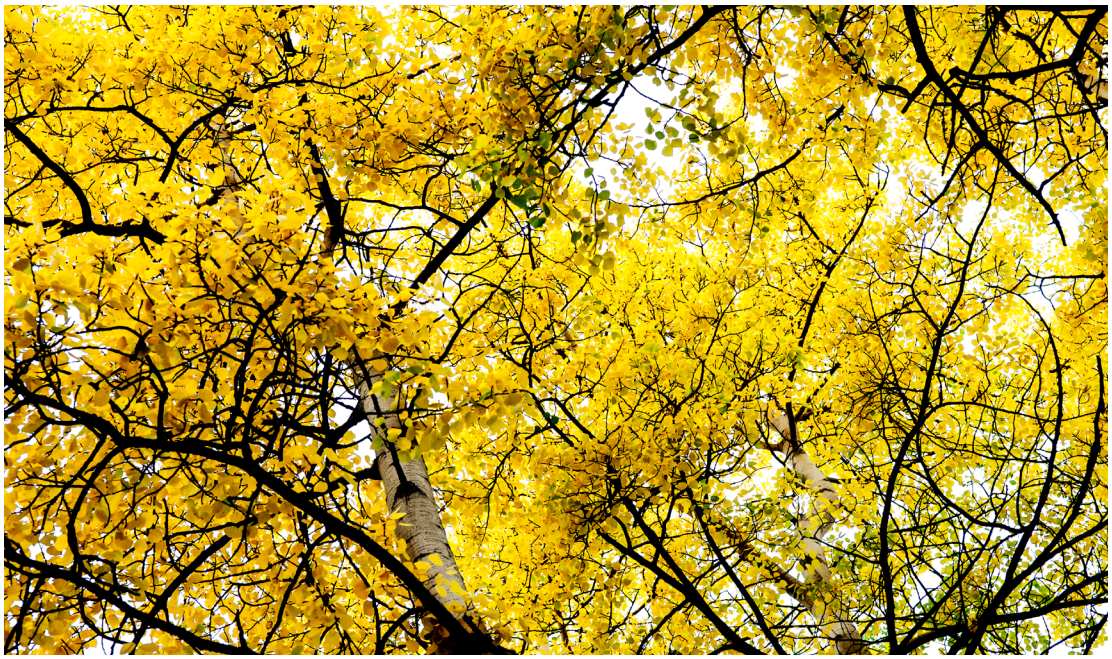
Predatory birds (or raptors), including harriers, hawks, eagles, falcons, and owls, are well represented in Denali. Species nesting in Denali include osprey (rare), northern harrier, bald eagle, sharp-shinned hawk, northern goshawk, red-tailed hawk, golden eagle, gyrfalcon, peregrine falcon, merlin, American kestrel, great-horned owl, northern hawk owl, great gray owl (rare), short-eared owl, and boreal owl. Migrants and occasional visitors include rough-legged hawk and snowy owl. Most of the diurnal raptors (the harriers, hawks, eagles, and falcons) are migratory. Exceptions to this include gyrfalcons and northern goshawks. Gyrfalcons are the largest falcon in the world, and they nest only in Arctic regions. Adult gyrfalcons usually remain on or near their nesting grounds throughout the year unless they can't find food. Juvenile gyrfalcons are more likely to move away from the nesting grounds during the winter in search of food. Northern goshawks are usually year-round residents but will leave this area when food is scarce. Most of Denali's owls are year-round residents, with the exception of short-eared owls.

Shorebirds nesting at higher elevations include American golden plover, upland sandpiper, surfbird, and Baird's sandpiper. Shorebirds nesting at lower elevations include semi-palmated plover, greater and lesser yellowlegs, solitary sandpiper, wandering tattler, spotted sandpiper, whimbrel, least sandpiper, long-billed dowitcher, common snipe, and red-necked phalarope. These globetrotters are a delight to watch in Denali. For example, the American golden plover has exquisite plumage, the Wandering Tattler has an evocative voice, and both span the globe in their migrations (they winter in South America). Surfbirds, who spend most of their lives along coastal areas, nest in the mountainous regions of Denali. A list of the BR's 137 birds species is available on the NPSpecies website.

Plant Communities

Cloudberry is a low-growing herb in the rose family (Rosaceae) with white flowers, large

NPS/TIM RAINSR



Quaking aspen (*Populus balsamifera*) in Denali's autumn.

five-lobed and delicious pink-yellow berries. This species occurs in bogs and tussock tundra from the lowlands into the subalpine zone of Denali. Humans have harvested their delicious pink-yellow berries for centuries. *Betula nana* (dwarf birch) is a deciduous perennial shrub with rounded leaves and dark resinous spots covering young twigs that occurs widely across Denali from lowlands into the alpine zone. *Betula neoalaskana* (resin birch) is the most abundant deciduous tree in Alaska, occurring across forested regions of Denali (especially after fires) and rarely in subalpine sites. Mature trees are instantly recognizable for their straight, pale trunks with papery, peeling bark. Birch has been important to humans as a source of weaving material, syrup, and other medicinal uses. Finally, Fireweed (Onagraceae) is one of the most recognizable plants of the north. Fireweed is a tall herb, used in teas, and other edible uses, with a spike of bright pink flowers, found along roadsides, occurring widely in meadows, floodplains, around animal burrows and in burned areas.

Vascular Plants

In Denali's terrestrial ecosystems, autotrophs (primarily plants) form the foundation of food webs, and provide not only the primary carbon source sustaining our ecosystems, but also define the structural and spatial attributes of "habitat" for animals living there. The vegetation of a site dictates in many ways whether and how it will be used by everything from insects and nematodes to moose and grizzly bears. For example, caribou prefer open, low statured vegetation that allows them to see long distances and contains high-value forage, whereas moose prefer boreal areas with dense willow shrubs that provide both hiding cover and their preferred browse.

Vascular plants have specialized tissues that allows them to translocate nutrients and water throughout the organism whereas non-vascular plants must absorb solutes and moisture from their surroundings. Vascular plants reproduce from spores or seeds. Denali is home to more than 750 vascular plant species encompassing 74 plant families. A checklist of Denali BR's vascular plants is available on the NPSpecies website. The major tree species are white and black spruce (*Picea glauca* and *P. mariana*), resin birch (*Betula neoalaskana*), balsam poplar and quaking aspen (*Populus balsamifera* and *P. tremuloides*). The primary disturbance vectors in our forests include fire and flooding from shifting sediment-laden glacial rivers.

In contrast to most other areas of the world, Denali's alpine zone is the major center of biodiversity for vascular plants, lichens and



NPS/TIM RAINS

The tundra is a beautiful mix of vascular and nonvascular plants.

mosses, not the more productive lowland areas. The low-statured and discontinuous vegetation mosaic in alpine tundra areas is home to a majority of the vascular and non-vascular species that occur in the BR, with fewer species occurring in lowland areas. A warming climate represents a threat to the biodiversity of this highly diverse region, as tundra plants are often out-competed by larger-statured woody vegetation when warming ameliorates conditions in mountainous areas.

Non-Vascular Plants

The more than 500 species of non-vascular plants in the park include two distantly related groups: bryophytes (mosses, liverworts, hornworts) and algae. Of these, researchers and managers know the most about the group's largest in stature with 380 moss and 119 liverwort taxa have been formally documented as occurring within park boundaries. Mosses and liverworts are small herbaceous plants capable of growing in a variety of habitats. They are often the first to colonize a freshly disturbed site, with some species prospering in the bare, sandy soil of the alpine or along gravel bars, and others carpeting the soil after a fire. Mosses and lichens serve as important hosts to cyanobacteria which fix nitrogen and provide nutrients in otherwise nutrient-poor environments. Feathermosses (a group of particularly large mosses), have the noteworthy ability to form extensive, thick mats on the forest floor effectively insulating the soil from the air above. Cold soils can be prohibitive for some species of vascular plants and certain decomposition processes, thus the presence of non-vascular plants is paramount for a diverse plant community.

Fungi, Bacteria, and Protists

Denali Park records indicate the presence of over 500 species of mushrooms and other fungi. Lichens, more formally known as lichenized fungi, are perhaps the most visible members of this group and thus contribute the most species to this tally, with 459 species currently documented as occurring within the BR (Roland et al. 2013). These fascinating organisms consist of a fungus and an algal and/or cyanobacterial photosynthetic partner growing in symbiosis. Fungi contribute greatly to ecosystem functioning, and without them, the boreal environment would be devoid of many of its most ubiquitous and interesting plants. For example, many species of trees and shrubs maintain symbiotic relationships between their roots and underground fungal hyphae, greatly increasing the ability of the plant to garner water and nutrients from the environment. In orchid species, this mycorrhizal relationship is thought to be obligatory.

Several other groups of organisms such as slime molds, bacteria, and protists contribute to the park's ecosystem functioning acting as primary producers, decomposers, and significant pathogens of animals and plants. While little is known about most of these organisms, the preservation of their habitat and natural function is likely critical to the more obvious inhabitants of Denali's landscape.

3.4 Specify whether any recent/updated ecosystem services assessment has been done for the biosphere reserve since its nomination/last report. If yes, please specify and indicate if and how this is being used in the management plan.

A single summary assessment of the BR's natural resources condition was completed in 2011 (Drazkowski B. et al. 2011), and describes the state of the BR's resources from an ecosystem service perspective. In section 3.2 and its respective supporting sections (4, 5, and 6) there are individual issue-driven efforts to assess. This information is used directly in the management of the BR through an adaptive management framework integrated into the agreements that form the areas of partnership and cooperation as well as the NEPA decision making structure (section 7) that informs the management of the core, managed use area, and transition zones.



NPS

A group of Alaskan youth BR backcountry volunteers participating in an Alaska Geographic sponsored field course.

Section 4. The Conservation Function

This refers to programmes that seek to protect biodiversity at landscape and site levels and/or ecological functions that provide ecosystem goods and services in the biosphere reserve. While actions to address this function might be focused on core area(s) and buffer zone(s), ecosystem dynamics occur across a range of spatial and temporal scales throughout the biosphere reserve and beyond.

In Murie's 1963 publication, T*he Birds of Mt McKinley, Alaska* he states holistically and succinctly the conservation function of Denali Biosphere:

> *In McKinley Park the visitor has the rare opportunity to enjoy northern landscapes, a variety of lichens and flowers, and grizzlies, caribou, Dall's sheep, perhaps a wolf or a wolverine, and a number of birds in their northern breeding grounds. Of special interest among the birds are three species of ptarmigan, each with a specialized voice and an inclination to use it. There are shorebirds, two of which, the surfbird and the wandering tattler, are of special interest because most of the nesting data on them have been gathered in the park. The arctic warbler and the wheatear, visitors from Asia, are relatively common. The golden eagle, unmolested and free, may frequently be seen soaring in the blue sky over its mountain home. May this magnificent bird and other migrants, survive the many new hazards in the south and continue returning each spring in the future, to contribute beauty and spirit to this northern wilderness.*

The foresight of Adolph Murie is evident in this passage from his book. Murie and others realized that Denali is not isolated from the environmental hazards created by humans and that its migratory birds face an increasing number of threats on their migratory journeys and wintering grounds. Murie, along with other naturalists and scientists including Charles Sheldon, Joseph Dixon, and George Wright, all realized the importance of preserving the ecosystems and wildlife of Denali in the rapidly changing world.

NPS



Culture Camp 2010 in Denali. Youth across Alaska work with BR archeologists on a dig to date and record a cultural site.

4.1 Significant changes (if any) in the main habitat types, ecosystems, species or varieties of traditional or economic importance identified for the biosphere reserve, including natural processes or events, main human impacts, and/or relevant management practices (since the last report).

Monitoring changes in the structure and function of the BR's ecosystem is the primary goal of the BR's science team and by extension, the focus of much research conducted by partners and academic investigators. The "vital signs" monitored by the Central Alaska Inventory and Monitoring Program focus on measuring such changes and a series of reports are available on the CAKN website. The BR also has a repeat photography website that demonstrates these changes with photographic pairs that were, in many cases, taken 100 years apart. The vast majority of the changes are attributed to natural succession and climate change.

Major trends include shrub-line moving up in elevation with avian communities responding to changes in shrub distribution (Roland et al. 2013); an increase in the severity, duration, and frequency of wildland fires, and thawing permafrost resulting in changes in land-cover and hydrology. The stories and results from these well studied phenomena are well represented in the BR's literature.

4.2 Describe the main conservation programmes that have been conducted in the biosphere reserve over the past ten years as well as current on-going ones. Note their main goals and the scope of activities, e.g., biotic inventories, species-at-risk, landscape analyses, conservation stewardship actions. Cross reference to other sections below where appropriate.

The Science and Resources Team is the catalyst of research and development, facilitating the integration of sound science into management. This group works closely with our researchers, the wilderness coordinator, and the planning chief to balance research needs, public acceptance, and the integrity of wilderness character. It is our the BR's "go-to" group for translating science into management, research, technical assistance, education, citizen science, youth professional development and diversity initiatives, and research permitting.

The Murie Science and Learning Center is the organization that brings together all science conducted in the park to present it to, and engage with, the public. The MSLC holds distance learning courses, provides



NPS

Cultural landscape of Denali BR: the historic headquarters, circa 1930, are used today as Denali National Park and Preserve headquarters.

real time data and support to visitors, hosts researchers, hosts and creates youth programs, holds numerous field courses led by park and visiting scientists during the summer (week long courses for the public, camping and learning out in the Biosphere Region). The MSLC also holds numerous talks, lectures, and a weekly popular lecture series of environmental change, and new research in the Denali Biosphere Region. The Center holds a biennial science conference that is open to professionals and the public. We periodically support other national parks through the Central Alaska Monitoring Network.

Cultural Resources. This division of the BR staff provides leadership that integrates park divisions to achieve cultural resource protection in coordination with the State Historic Preservation Office, affiliated Tribal Councils, and the National Historic Preservation Act.

There are five Cultural Resource distinctions that apply to the Denali Biosphere listed below; an abbreviated list of continuing projects follow (see section 9 for annex of ongoing research in the BR):

1. archeology sites
2. historic structures
3. ethnographic resources
4. cultural landscapes
5. museum collections

Denali BR has 350 known archeological sites, however, less than 0.8% of the park has been surveyed for cultural resources, of which less than 0.01% of Denali and surrounding terrain.

Historic structures and cultural landscapes are often connected: a cultural landscape is a geographic area, including both cultural and natural resources and the wildlife of domestic animals therein, associated with an historic event, activity, person, or exhibiting other cultural values. Denali has 136 documented historic structures, 16 identified Cultural Landscapes, and five completed cultural landscape inventory studies thus far (including: Park Road Cabins, Birch Creek, Fannie Quigley Residence).

Ethnographic resources are of particular importance to the BR, because they are sites, structures, objects, or entire landscapes that

NPS



Ethnographic Landscape of Denali BR, circa 1960. This landscape epitomizes a multipurpose area for harvesting of berries and game, to traversing it via historic dog mushing trails.

have significance to indigenous people. There have been multiple studies conducted in the northwest section of the BR. Oral histories, recording and inventories of language, traditional practices and stories are ongoing in other sections of the BR with significant long term human habitation and connection to the land.

The museum collections are vital to the BR because they hold the physical and digital records of the BR's history, captured in photos, films, objects, sounds, natural, social and cultural research. As of 2015, the museum houses 782,560 archeological objects, history, archives, art, biology, ethnology, among others.

Table 4.2. Ongoing cultural resource Inventories.

Cultural Landscape Inventory Records	Ethnographic Oral and Life Histories	National Register Form	Traditional Use Study	Archeological Identification/ Evaluation Study
Kantishna Historic Mining Landscape	Collins Sisters	Henning Cabin	Athabascan Cultural Systems - Cultural Landscape Study and Report	Documenting Traplines and Trapping Activities in Two Alaska Parks
Kantishna Hydraulic Mining Company Ditch	Murie Family	Horseshoe Lake Trail	Develop Community User Profiles of Subsistence Harvest	The Archeology and Geomorphology of Ancient Lake Minchumina
22 Gulch	Trapping Histories		Enhance Monitoring Information	
Alpha Ridge	Denali Park Road CCC Workers			
Park Road Cabins				
Teklanika Archeological District				
Birch Creek				



NPS/KIANA CARLSON

Denali BR Museum Collections. Archeological finds, rare specimens, and books from the BR are recorded, stored and shared here with other museums and collections internationally.

Planning and Compliance is the gatekeeper for all park undertakings and management actions as well as outreach to affiliated community organizations, subsistence communities and native corporations. Park planning and compliance is complex with numerous private landowner in-holdings and boundary issues. Adding to this complexity is the hundreds of projects annually that require park access and permission to stay and conduct research, art, videography, youth tours, and educational trips in designated wilderness areas, and other sensitive hard-to-access places in the BR. In addition to the NEPA process described section 7, minimum requirements analysis are conducted to determine appropriate projects and method within designated wilderness. Finally, this group reviews dozens of road projects totaling millions of dollars to the small and routine.

Natural Resources Management is the implementation arm of the Resources and Science Division, primarily focused on ecosystem services, quality of visitor experiences, conservation biology, geohazard, park road capacity monitoring, and restoration activities. This group integrates with researchers early and often to prepare foundational scientific understanding of issues as well as establish statistically and biologically meaningful projects. The program has many recognized efforts but none more than its successes with long-term monitoring of Dall's sheep, bears, wolves, Air quality, geohazards along the park road, plant communities restoration.

Fire Management. The primary objective of the organization is to manage all naturally caused wildfire events as an ecological process to the greatest extent practical while minimizing risk to life (public and firefighters), private property and sensitive resources. This objective is accomplished through extensive pre-planning and collaboration with stakeholders and organizations. Almost the entire BR (with the exception of the managed use area) and the vast majority of Alaska has identified where risk is generally acceptable to allow natural wildfire to occur to the fullest extent and duration. Approximately 97% of Denali's land base is in this designation. Conversely, due to the presence of people, infrastructure, sensitive features and/or adjacent lands stakeholders concerns the remaining 3% of the Denali land base is prioritized to have increased fire protection and/or suppression. In these areas this does not preclude the presence of naturally occurring wildfire, rather a measured analysis of the risks and benefits is completed for each new natural ignition prior to developing

a management strategy (full suppression, partial containment, or monitor).

In addition to extensive pre-planning, a significant portion of the fire program's responsibility is either reducing or mitigating risk. Risk mitigation efforts focus on advancing ecological knowledge (fire ecology – natural fire regime and effects monitoring); fuel management around sensitive feature (structures, facilities, cultural resources, high density public areas); public and stakeholder engagement and support (fire communication and interagency agreements) and regular fire behavior monitoring of active wildfires. Of the 3% of Denali's land base, where wildfire is not generally allowed to burn naturally, Denali is exploring options for re-introducing fire on the landscape through mechanical treatments and prescribed fire at time frames consistent with the naturally occurring wildfire regime.

Preparedness and Response. Prepare ourselves and each other to be the best we can be – responsive to emergencies, emergent issues and the routine; be resilient in the face of change; and to have the adaptive capacity to turn challenges into opportunities for better stewardship of the resources we protect. The BR manages Denali, which attracts mountaineers from around the world. To manage the influx of people into a very high risk environment, the BR has a robust climbing safety operation which includes highly skilled mountaineering Rangers and a high elevation helicopter. Over a dozen life-saving technical rescues are conducted each season.

Human Dimensions. We encourage and facilitate democratic processes that are inclusive of our shared history, value communities, validate traditional ecological knowledge, and anticipate the needs of future generations to a rapidly changing global environment. Social science falls under natural resource management, and relates to visitor experience protection, unique landscapes and viewscapes protection, and soundscapes monitoring. Research in this area that contributes to the adaptive management of the BR include acoustic norm and dynamism development, local economic studies, visitor perception and engagement with the natural landscape, visitor behavior analyses, identity and place attachment, and social ecosystem services valuation studies.

Ecosystem Ecology. Steward ecosystem processes, communities and species so as to support resiliency and adaptive capacity. Avian ecology for example, is one vital aspect of adaptive capacity of the BR. Denali's bird life is made up of migratory birds from all over the globe and a hardy group of birds that remain in the area year-round. The abundance of birds in Denali ebbs and flows across the seasons, increasing significantly as migrants return to Denali in spring and decreasing when they depart in autumn. Denali's migratory birds face significant threats on their wintering grounds including habitat alteration and energy developments. Even in the seemingly pristine environments of Denali, year-round residents face changes in habitat, climate, and the presence of persistent organic pollutants. Broad-scale threats such as chemical pollutants that remain in our environment and global climatic changes may have long-lasting and far-reaching effects on Denali's birds. On a local scale, increases in human activities may alter the habitats and behavior of many species of birds.

Restoration Ecology. Denali BR has been on the forefront of developing techniques to reclaim and restore subarctic riparian systems that were impacted by gold mining. The Kantishna mining district was an active gold mining district from 1905-1986. These lands were added to Denali National Park in 1980 and mining ceased in 1986 when it was determined that most mine operations were not compliant with water quality standards. Many stream beds had been denuded of vegetation and surface substrate altered by tailing deposits. Beginning in 1990, BR managers dedicated resources to develop methods and implement reclamation and revegetation project on several of the most impacted areas. Many of these areas are now functioning wetland riparian ecosystems. These revegetation techniques are now used

throughout the subarctic region (Densmore 2005)

Landscape Ecology. The vastness, habitat diversity, and dynamic physical process present in and around the Denali BR make it an ideas study site to further the state of knowledge on how the juxtaposition, size, and shape of habitat (plant communities) influence wildlife population dynamics. This is an emerging research topic as long term wildlife population and plant community monitoring dataset mature. The 30-year legacy of measuring landscape components is ready to launch new scientific inquiry into landscape and regional scale ecological investigations.

Conservation Biology. Conservation biology is at the core of many of the BR's scientific traditions. It is fundamental to the mission of the National Park Service, which is "…. to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (Denali National Park and Preserve Foundation Statement 2014).

4.3 Development issues (e.g., stewardship for conservation on private lands used for other purposes)?

As noted in several sections of this document, the primary activity in this BR is recreation and tourism. The infrastructure and development necessary to support such a system is linked to conservation primarily through cumulative conservation impacts of increased visitation and also in the greening of technology. Since 2005, the NPS has built the BR's first front country visitor center, an educational book store, an education center, and a cafe. In the western portion of the park road corridor the NPS replaced an aging visitor center with a Leadership in Energy and Environmental Design (LEED)-certified, state-of-the-art, off-grid visitor center. A new LEED certified emergency service facility was constructed in the BR's administrative site. In the town of Talkeetna the new Walter Harper Ranger Station was constructed as a mountaineering contact station honoring Water Harper, the first person to set foot on the summit of Denali and a local Athabascan Native. There are private inholdings in a portion of the managed use area at the end of the Denali Park Road in the managed use area. These private inholdings, some of which were originally mining claims, are primarily used for tourism (lodging, guided hiking into the park). Because these in-holders rely on the brief and extensive BR generated ecotourism, they also cooperate with the BR and surrounding area conservation and educational organizations to promote conservation. One inholding in the managed use zone is a small outcrop of rock in the midst of the massive Ruth Glacier on the south flank of Denali Mt. This outcrop hosts a small hut that is rented out during the summer for expensive overnight stays, in which the benefits accrue to the town of Talkeetna, south of the Denali National Park and Preserve and in the Mat-Su Borough of Alaska.

4.4 How do you assess the effectiveness of actions or strategies applied? (Describe the methods, indicators used).

The need to evaluate the cumulative impacts of climate change, contaminants (see Landers et al. 2008), consumptive use of wildlife resources, increased visitation and recreation on conservation has been elevated within the last decades. BR staff and partners are engaging on a variety of research fronts through the CAKN monitoring program, BR research staff, and university based investigators to track key indicators of ecosystem and infrastructure health and to inform the linkages. These trends and supporting information is available for the BR in the 2012 Denali - State of the Park Report (https://www.nps.gov/stateoftheparks/dena/).

4.5 What are the main factors that influenced (positively or negatively) the successes of conservation efforts in the entire biosphere reserve? Given the experiences and lessons learned in the past ten years, what new strategies or

approaches will be most effective for conservation for sustainable development?

Fostering strong collaborative relationships with the other agencies and government land management entities will continue as particularly important, given that protected area boundaries are permeable to wildlife. Neither ecosystem process nor the anthropogenic factors that impact them are affected by political boundaries; thus, the transition zone functions as vast extension of the BR in supporting wildlife populations, ecosystem processes, and migratory pathways. It also has the potential to impact the BR due management practice that might harm resource the BR seeks to protect. Partnerships and Agreements provide a framework for conservation, sustainable development, education, and engagement with adjacent land managers and the university based research community. Finding and leverage "common ground" between management entities that have opposing management objects will reveal a path forward when a framework for collaboration is in place. In the Denali BR this tension is expressed between the State and Federal governments over managing wildlife for viewing versus consumption. Recent collaborative between the federal and state governments on the factors affecting wolf viewing opportunities has set the stage for additional collaboration and dialog on conservation issues affecting the core, managed use area and transition zones that will be most effective in the future. Partnerships and agreements are the framework and authority structure we have, as explained in section 7 of this document.

4.6 Other comments/observations from a biosphere reserve perspective:

None at this time.



NPS

Villagers of Nikolai spend much of June and July fishing in the BR. Traditional fishing practices are passed from generation to generation, despite the use of motorized access.

Section 5. The Development Function

This refers to programmes that address sustainability issues at the individual livelihood and community levels, including economic trends in different sectors that drive the need to innovate and/or adapt, the main adaptive strategies being implemented within the biosphere reserve, and initiatives to develop certain sectors such as tourism to complement and/or compensate for losses in other markets, employment, and community well-being over the past ten years.

People have traveled through the BR region for thousands of years. Although most of the BR's visitors now arrive via the George Parks Highway, people historically have used a variety of transportation methods to access the area. Over the course of the last 100 years, visiting the park has changed drastically in terms of technology, infrastructure, and the amount of time it takes to travel to a remote section of Interior Alaska.

In the early days of then, Mt McKinley National Park, the few people that visited the park arrived by train and were guided on horse-drawn tours to encampments within the now BR core zone. Local residents and Athabascans especially, used dog teams, horses and foot to enter the area of Mt. McKinley to hunt, prospect, forage and fish. Nowadays, people arrive by the tens of thousands, by train, private car, tour bus, or small aircraft, to see the park from the windows of the shuttle and tour busses. The park bus based transportation system was developed before the designation of the Denali Biosphere Region. This shuttle system connects people from developed areas with food/lodging to the heart of the core zone for wildlife viewing, and hiking and climbing. The transportation plan, which restricted private vehicles, was initiated in 1972 to eliminate the high traffic volume that was anticipated with the opening of the highway linking Anchorage and Fairbanks and the damage traffic could cause to wildlife viewing opportunities and wilderness. Recently, the BR has begun experimenting with alternative fuel and hybrid busses for the visitor transportation system.

NPS



Tourism dominates the local non-subsistence economy, especially in the busy summer season (June-August).

NPS



Historically, local families and visitors alike would arrive to Denali via the Alaska Railroad to this historic station, circa 1939. Hundreds of thousands of visitors still arrive today by train to Mckinley Station.

The Denali BR also has a historic sled dog kennel that sustains the traditions of the local communities of the BR, the history, and continues to provide sustainable transit during the winter. Dog teams are used every winter, spring and late fall to supply outlying ranger stations with provisions, to conduct scientific monitoring of glaciers, patrol the BR boundaries, and engage in clean-up and staging building materials to remote locations. Many in the communities near the BR are "mushers" by trade and for personal recreation.

The Denali BR contracts with Doyon/ Aramark Joint Ventures (JV) to run the visitor transportation system, and food services. JV contribute facilities for the zero landfill initiative of the BR, and engage in cooperative planning of facility development in the managed use area. Additionally, the BR, along with the businesses in the communities of Healy and Cantwell, participate with the tourism industry to streamline transit and other development in the transition zone.



NPS

The working sled dogs of Denali, circa 1941. Today, motorized access is not allowed in the BR core and buffer zones – sled dogs are still used to supply and transport BR staff working in the wilderness. They also work in clean up activities, search and rescues, and monitoring of resources.

5.1 Briefly describe the prevailing trends over the past decade in each main sector of the economic base of the biosphere reserve (e.g., agriculture and forest activities, renewable resources, non-renewable resources, manufacturing and construction, tourism and other service industries).

Recreation and tourism is the primary sector in the BR's local economy. Tourism has been on a consistent rise to the BR, primarily due to a healthier economy, lower gas prices, and the BR's unique landmark of Denali. Over the past decade many new businesses, focused on tourism, have developed and flourished within the BR's Zone of Partnership and Cooperation. Seasonal employment opportunities have increased to the point where more than half of the seasonal positions are filled by people from other parts of the world. Currently local businesses recruit young staff members from Eastern European countries for more than 60% of the positions. Construction focused on tourist and staff accommodations has been proceeding at a rapid rate for the past decade. In 2008, tourism contributed $104 million, to the local economy. Tourism has grown by over 25% since 2008, thus current estimates of the economic impact of tourism is about $130 million per year (Stynes 2011). In the last decade, many new facilities and trails have been built with the Denali BR's entrance area. The Denali Visitor Center, Morino Grill, bookstore, Murie Science and Learning Center, Savage Alpine Trail, and improvements to Triple Lakes Trail are all new developments that provide visitor opportunities to enjoy and learn about the BR while contributing to the local economy by buying food, educational materials, and purchasing transport and tours into the BR's interior. These additional visitor facilities and services have changed how visitors enjoy the BR. Currently, an average visitor spends more than two days in the local area compared to a decade ago when visitors only spent one day. The percentage of daily visits that include travel into the BR's interior has declined because of the increased recreational opportunities in the BR's entrance area and the transition zone just outside of the national park.

Coal mining, the other significant economic sector, fluctuates based on global market demand and has been declining slightly in recent years due to declining prices and downturn in global demand. In the past, the local coal mine benefited from several lucrative export contracts. Currently the mine holds no international contracts and relies on relatively stable local markets. The

GOLDEN VALLEY ELECTRIC COMPANY, 2013



Eva Creek Wind Project.

mine is operating at a lower capacity due to the decrease in demand. However, layoff have been few. Instead of severing long-term employees, mine managers have scaled back on the workers hours. With the addition of a new 50-megawatt (MW) generation facility in 2015, coal fired electrical generation has increased in the BR's transition zone from 25 MW to 75 MW. The BR contributed to mitigation efforts that reduced the allowable emissions, which reduces impacts to local air quality and visibility, to remain compatible with the BR's designation as a Class I airshed under the Clean Air Act. While coal is associated with environmental impacts, the local coal is low in sulfur, is burned on site in state-of-the art generation facilities, and is fitted with the best available retrofit technology for emissions controls. This helps lower the amount of diesel fuel transiting the State's roads and waterways.

Additionally, the Usebelli Coal Mine is committed to sustainable business practices for the health of their employees and the environment in which they operates. For example, the Usebelli Coal Mine has been able to examine re-vegetation methods ranging from the natural reinvasion to active seeding, transplants and/or selected growth media to facilitate plant community development. The research indicated seeded grasses have a high ground cover at first while the vegetative litter and local seed sources are essentially nonexistent. Over the next five years, ground cover from litter develops from the seeded grasses and then declines for another five years. From this point on, ground cover sharply increases. The conclusion is that initial grasses appear to assist soil development, but it takes 10 growing seasons to see the effect.

In 2012, the nearby new Eva Creek 25 MW wind power generation facility went online. This facility has a capacity of 24.6 megawatts using 12 Senvion cold-climate turbines (view daily output of the Eva Creek Wind facility: www.gvea.com). In 2015, the Eva Creek Wind facility contributed 74,784,000 kilowatt-hours to the grid; enough to power 9,190 average Interior-Alaska homes (660 kWh per month). 2016 so far has seen 77,142,270 kWh of a possible 237,340,800 kWh.

Additionally, these two new electrical generation facilities provided the local economy with several additional employment opportunities. 5.2 Describe the tourism industry in the biosphere reserve. Has tourism increased or decreased since nomination or the last periodic review? What new projects or initiatives have been undertaken? What types of tourism activities? What effect have these activities had on the economy, ecology

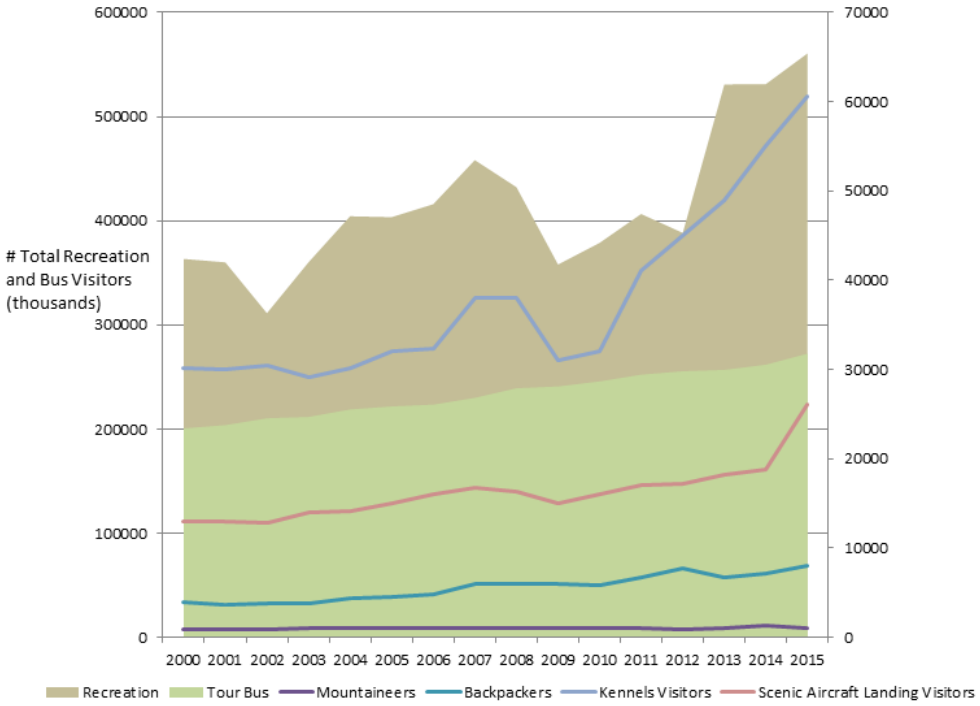


Figure 5.2 Tourism Trends in Denali BR. Number of individuals by year shown by activity: shuttle bus visitors in tens of thousands (left axis) and other recreation visitors in thousands (right axis) Source: Denali NPS Social Science Public Use Statistics Database

and society of the biosphere reserve? Are there any studies that examine whether designation of the area as a biosphere reserve has influenced the number of tourists? Please provide the bibliographic information of any studies and/or a paper copy in an annex.

Visitation initially increased rapidly after BR designation in 1976, from some 45,000 visitors to approximately 550,000 visits; in 2016. Figure 5.2, below, shows the tourism trends in Denali BR from 2000- 2015. The increase in visitation is not likely due to the BR designation but rather the popularity of Alaska as a travel destination. Alaska's scenery, remoteness, and wildlife viewing opportunities attracted over 1.8 million visitors (to the state) in 2015, about 30% of them come to the Denali BR (DOI National Economic Impact Report 2011). Visitors arriving to coastal Alaska by cruise ship and participating "Denali extensions" accounts for about ⅔ of the BR's visitation. Independent travelers from around the world account for the remaining visitation. Denali also ranks high as a cultural symbol around the world due the presence of the highest peak in North America. Beyond viewing wildlife and scenery, other popular activities include mountaineering, adventure backpacking, fishing, sport hunting, flightseeing, rafting, zip lining, dog sledding, aurora borealis viewing, skiing, snowmobiling, riding all-terrain vehicles, and photography. Much of the draw centers around the presence of viewable wildlife and game. Statewide, wildlife viewing contributes 2.7 billion USD to the State's economy (ECONorthWest 2011). Estimates for the non-consumptive value of wildlife for the Denali BR are not available. Spikes in visitation also appear to be correlated with a good economy and relatively cheap fuel prices.

Denali National Park has utilized the BR brand on the park's webpage, apps, magazines and other printed material, informing visitors before they arrive that the park they seek to enjoy is also a unique place for its Biosphere Region designation. We assume most of the visitors to Denali recognize the National Park Service, but have the opportunity to learn the importance of Denali as part of an international network of protected BRs. Additionally, some BR staff rangers active in leading visitors into the BR core area discuss the significance of BR designation and the MAB program. Learning that the area is

recognized by UNESCO as globally significant adds value to their travel investment.

5.3 When applicable, describe other key sectors and uses such as agriculture, fishing, forestry. Have they increased or decreased since the nomination or the last periodic review? What kind of new projects or initiatives have been undertaken? What effect have they had on the economy and ecology of the biosphere reserve, and on its biodiversity? Are there any studies that examine whether designation as a biosphere reserve has influenced the frequency of its activities? If so, provide the bibliographic information of these studies and/or a paper copy in an annex.

Local residence zone community members have access to subsistence resources with the BR's managed use area. Subsistence harvests of firewood, fish, moose, and furbearers (marten, ermine, wolf) occurs in suitable habitats at lower elevations and close to rivers where winter travel is possible by dog sled and snowmobile. The frequency and rate of harvest has been stable and sustainable for the past few decades.

5.4 How do economic activities in the biosphere benefit local communities?

Tourism partners such as Doyon/Aramark, Holland America-Princess, Kantishna Road House, Denali backcountry Lodge, Disney and many others, display good business practice for local hires, returning and long-standing employees, and respect for BR community residents. Additionally, Aramark, Princess/ Holland America, who all attract and service the tourism in the BR- also are beginning to take responsibility for waste generated by the demand they seek to grow. Benefits accrue to local communities via recycling programs, facility improvement, and service sector job growth. Other indirect effects include the channeling of limited construction funds to the Denali BR region (for the highway), amenities development and amenity-driven population growth, wide recognition of Denali as hosting unique ecosystems, and human-environment dynamics that attracts a good deal of research and operation funds.

Local communities benefit from the tourism industry by directly participating in the tourism industry as business owners, as employees of tourism related businesses, and as residents benefiting from the local government's services. The BR also directly provides opportunities for hunters, and hunting guides, to harvest wildlife. Wildlife that disperse (an ecosystem service) from the BR's core zone into the managed use area, and transition zone provide opportunities for local rural residents to harvest subsistence wildlife and firewood resources. Opportunity, for urban and out-of-state hunters and their guides also exist in Managed Use and Zone of Partnership and Cooperation. The Denali Borough government and the services it provides is funded almost solely by taxing visitors through the local 7% bed tax. In 2015, the Denali Borough received about $3 million in bed tax and about $70 thousand in coal severance tax. While Healy, the largest local community, is largely a coal-industry driven town, it benefits from the Denali BR because the majority of the local school's funding is provided by the local bed tax. Other local government services including emergency services (fire and medical), hazard planning, and refuse management are all funded largely out of the local bed tax.

Total spending of visitors in the local area in 2008 is estimated at $151 million including $52 million on lodging, $24 million on restaurant meals/bar expenses, $17.7 million on tours and $47 million on transportation. Total spending is estimated by multiplying the spending averages by number of person-nights in the BR zones by each type of spending, and summing across segments. Denali BR visitor spending excluding transportation expenses is estimated at $104 million. The model is estimated from a typical consumer "basket" of goods (recreation and services).

Economic impacts of this spending on the Denali region (including Denali Borough and the South Denali region of Mat-Su Borough) was 1,530 jobs, $46.5 million in labor income

and $72.9 million value added (Department of Interior Economic Impact Report 2011). Local employment direct and indirect effects are lower than this level of spending would imply, but still a vital source of yearly income and amenities local communities rely on. The jobs/income ratio is lower than the State of Alaska, due to the highly seasonal nature of the local tourism economic sector and the leakages that accrue to large national, multi-national tour firms. Extractive industries (coal and other mining), and subsistence sectors provide the diversification needed for sustainable economic health.

Tourists are primarily mid-to upper-income earners, who travel to Denali Biosphere Region as part of an Alaska Cruise Tour Package, or as part of an adventure tour package that includes other nearby wild areas in Alaska. These visitors typically spend a great deal of time and money in local communities' lodging, restaurants, shops, raft and other adventure touring businesses. Some spend time in traditional Native subsistence communities, learning their way of life, and directly contributing money to the villages. The BR and its commercial partners provide the conservation function to balance a need for economic stability with resource and wilderness protection.

5.5 How do you assess the effectiveness of actions or strategies applied? (Describe the methods, indicators).

The BR's economic impact is assessed through occasional economic assessment funded by the NPS, the most recent being Stynes and Ackerman (2010). The economic impact of consumptive and non-consumptive wildlife-based recreation was analyzed recently by the Alaska Department of Fish and Game and EcoNorthwest (EcoNorthwest 2011). Regional and Statewide economic assessment of tourism and other sectors are conducted annually by the Alaska Department of Commerce, Community, and Economic Development. Effectiveness is measured in visitation levels, direct and indirect impacts to the local, regional, and statewide economy, and number of employment opportunities.

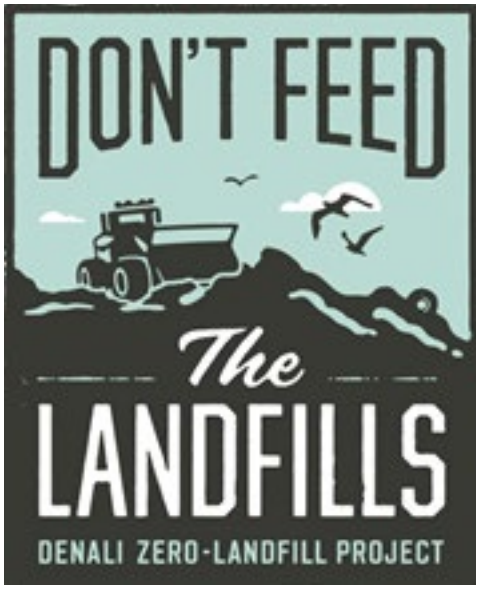
5.6 Community economic development initiatives. What programmes exist to promote comprehensive strategies for economic innovation, change, and adaptation within the biosphere reserve, and to what extent are they implemented?

The NPS offers specific business opportunities for commercial entities to provide products and services deemed necessary and/or appropriate within the core, managed use area, and transition zones. Some of these opportunities are offered as concession contracts which guarantee exclusivity, while others are offered as non-exclusive commercial use authorizations (CUAs). Both of these types of authorizations include stipulations or conditions that allow managers to set limits on, areas of operations, types of equipment, number of visitors on an activity, frequency of events, etc. The largest and most important business opportunity offered in the BR is the contract for transportation service. The concession run bus transportation, and the associated scenery and wildlife viewing by the BR's 350,000 visitors along the 90-mile-long Denali park road, is an epicenter of the local and regional economy. Traffic on the park road has a high potential to impact one of the BR's fundamental purposes of wildlife viewing; therefore, BR management has restricted traffic levels since prior to the BR's inception in 1972. Demand for bus seats exceeds supply on some days; thus, in 2012, BR managers published the Vehicle Management Plan (VMP) which presented a set of measurable indicators and standards of visitor experiences and wildlife habitat suitability for the park road. This plan sets the stage for an adaptive management framework linking the economic opportunity of maximizing the sale of bus seats to preserving wildlife viewing opportunities and habitat suitability. The VMP allows for an increase in level of traffics as long as these standards are not exceeded. This new adaptive management paradigm and has initiated a greater collaboration between BR management and the tour business. This collaboration is inspiring creativity and adaptation in meeting the shared goals of generating the highest level economic activity without impairing the BR's fundamental

resources that draws visitors from around the world.

The BR's vicinity economy is fundamentally recreation and tourism and the development initiatives are primarily related to that function. Within the transition zone, development activities are managed by the Denali Borough and the State of Alaska. These government are supportive of economic development as long as it complies with local zoning and environmental regulations. To foster sustainable development that supports recreation and outdoor pursuits, the National Park Service has a Rivers, Trails, and Conservation Assistance Program that provides planning support and funding to local governments for developing public recreational facilities such as trails, and access ramps for water based recreation in the Zone of Partnership and Cooperation.

5.7 Local business or other economic development initiatives. Are there specific "green" alternatives being undertaken to address sustainability issues? What relationships (if any) are there among these different activities?



The Green Parks Plan (GPP) (see Annex IV) and Zero Landfill Initiative (ZLI) project defines a collective vision and a long-term strategic plan for sustainable management of BR operations. A critical component of the implementation of the GPP will be informing and engaging parks staff, visitors, and community. The ZLI is a BR and Subaru led collaboration to divert waste from entering landfills. BR managers are expanding community wide recycling programs, and are introducing composting and digesting as significant waste management strategies.

5.8 Describe the main changes (if there are any) in terms of cultural values (religious, historical, political, social, ethnological) and others, if possible with distinction between material and intangible heritage. (c.f. UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage 1972 and UNESCO Convention for the Safeguard of the Intangible Cultural Heritage 2003.

In the American culture at large, that is the predominant influence in the region, no significant changes in cultural values has occurred. However, the BR is associated with three Athabascan (indigenous Alaskan) villages including Cantwell, Nikolai, and Telida. Nikoli is a viable community along the Kuskokwim River. However, many aspects of the Athabascan culture and language are disappearing. Alcoholism, drug abuse, and suicide the unfortunate latencies of social dislocation and and traditional-cultural decline- are prevalent in Nikolai. BR managers are working with Native councils to facilitate the revival of indigenous practices and oral histories between elders and youth. BR managers are also working with the last few native speakers of the local Athabascan dialect to transcribe tape recording from the 1970s that contain important stories and seasonal travel route information. BR managers have also gathered coordinates for specific geographic locations that are referenced in these stories. BR archaeologists are traveling to these backcountry sites and surveying for, and finding, evidence of occupation.

5.9 Community support facilities and services. What programmes in/for the biosphere reserve address issues such as job preparation and skills training, health and social services, and social justice questions. What are the relationships among them and with community economic development?

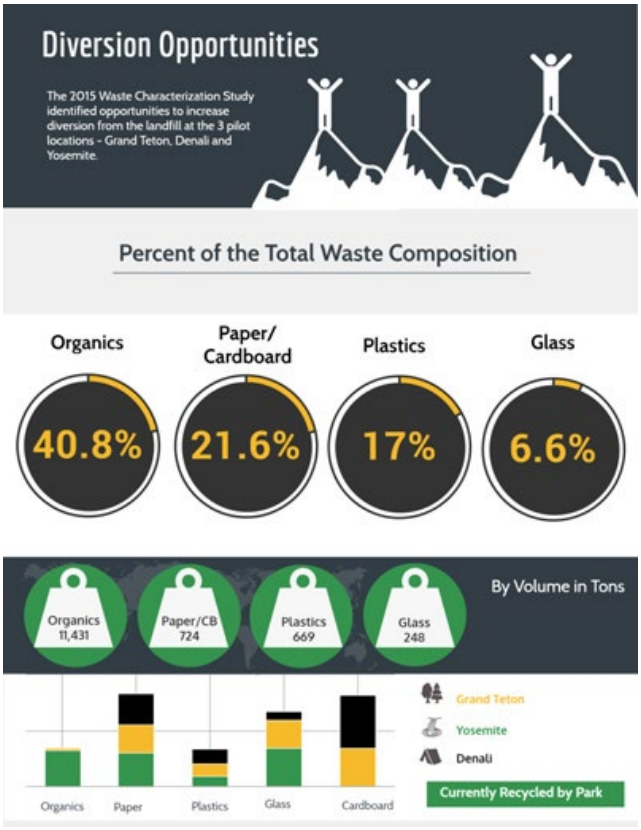
BR staff are engaged in job fairs, resume workshops and for the general public, and publications regarding job opportunities. The BR has a local youth-focused summer employment program (Youth Conservation Corps or YCC). Typically, most local high

school students that want to work in the BR are offered an opportunity. YCC positions in the Denali BR include: animal attendant (sled dogs), trail builder, traffic science technician, interpretation, museum curation technician, and recycling technician. The BR also has local hire program that gives priority to local year-round residents. Local hires directly affect the health and diversification of the local economy. Indirect, but substantial, effects of the BR in the diversification of the local economy is the tourism it draws, and the industry this creates. Additionally, through subsistence permits, the BR supports traditional livelihoods, traditional trade and market structures, as well as targeted craft and service industries for native subsistence villages.

The BR engages in social justice and social services directly in the community by staff engagement in local social, and environmental organizations that work to improve the sustainability and quality of life in the communities surrounding the BR. The BR staff engages in social justice indirectly via international research and cooperative networks (such as the NPS Arctic Inventory and Monitoring Network) to advance social justice of transpolar indigenous communities.

5.10 What indicators are in place to assess the effectiveness of activities aiming to foster sustainable development? What have these indicators shown?

As part of the Zero Landfill Initiative, the BR tracks waste management similarly and are showing similar declines as well as increases in recycling. We work also with businesses in the effective transition area to divert waste from the landfill and engage in wildlife friendly waste management practices. The BR also has solar panels on many buildings and preferentially purchase power generated by the local wind generation facility at Eva Creek. Overall we are aiming to foster a trend towards more sustainable outcomes, which we are achieving.



5.11 What are the main factors that influenced (positively or negatively) the success of development efforts in the entire biosphere reserve? Given the experiences and lessons learned in the past ten years, what new strategies or approaches will be most effective?

The rate of visitation and associated development activity has fluctuated based on economic cycles and fuel prices. Relationships with the BR's concession and other commercial partners, and local governments, particularly as expressed through partnerships and agreements, are the most important factors. The authority for the BR to collect concession franchise fees provides funding to maintain the infrastructure associated with providing bus access to the BR's core zone is also key to sustaining the BR's ability to support tourism.

NPS



Youth courses in the park combine outdoor experiences and learning.

Section 6. The Logistic Function

This refers to programs that enhance the capacity of people and organizations in the biosphere reserve to address both conservation and development issues for sustainable development as well as research, monitoring, demonstration projects and education needed to deal with the specific context and conditions of the biosphere reserve.

6.1 Describe the main institutions conducting research or monitoring in the biosphere reserve, and their programmes. Comment on organizational changes (if any) in these institutions over the past ten years as they relate to their work in the biosphere reserve.

The BR has an extensive network of research and monitoring. The Central Alaska Inventory and Monitoring Program (CAKN) has been operational since 2005 and monitors a set of measurable indicators (vital signs) of ecosystem health that were derived and ranked for funding by a broad team of scientists and managers from around the region. The CAKN Monitoring Plan (see Annex II) describes the rationale and approach behind each vital sign. Reports on status of these vital signs are published at annual to decadal intervals depending the vital signs sampling plan. The Denali BR has a staff of physical and biological scientists along with cultural resources staff that include an historian, anthropologist, and archeologist whose work generally address management challenges but also the pursuit of scholarship and science. These scholars and science staff work follows the priorities described in the Denali Resource Stewardship Strategy. The BR's Murie Science and Learning Center also facilitates research, often for early career scientist or graduate students, as part of its education mission.

These are a few highlights from the last ten years:

- Annual research permits have been growing steadily over the 10-year period, from around 10 to nearly 80 in 2015, representing approximately 40+ researchers per year, according to the National Park Service Research Permit Reporting System (source: www.nps.gov/irma/rprs).

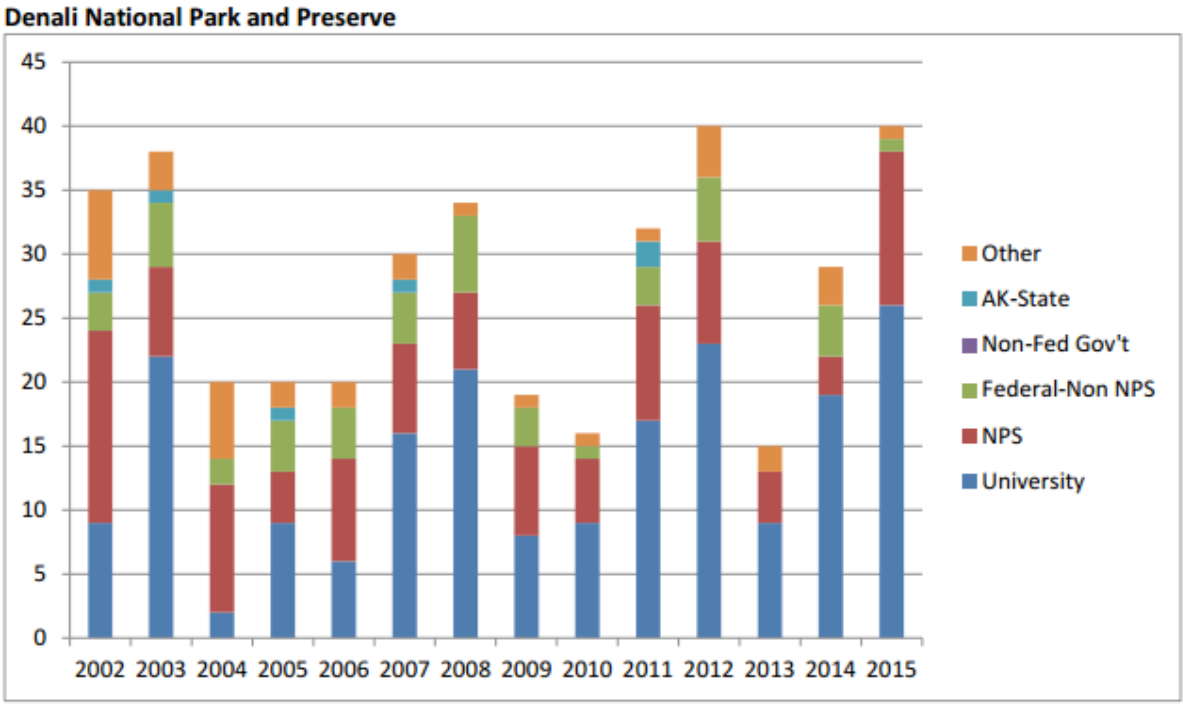


Figure 6.1. Number of research permits issued per year by recipient.

- Annually more than 20 university and research institutions participate in research/monitoring in the BR.
- Over the ten-year period it is estimated that more than 100 publications have been published.
- Leads in distance learning and other virtual experiences for youth across the entire U.S.
- Strengthened ties with communities with new partnerships and agreements with State, Borough, business and nonprofit organizations.
- Established Denali Education Center partnership, that allows for support from the BR for targeted programs for local youth, integration of traditional ecological knowledge into culture camps attended by local residents.
- Continues to grow service learning projects in the BR.
- Completed BR-wide inventory of natural and anthropogenic sounds.
- Completed BR-wide monitoring of plant communities.
- Completed BR-wide monitoring of wildlife, including avian species.
- Established stricter monitoring protocols of visitor use.

6.2 Summarize the main themes of research and monitoring undertaken over the past ten years and the area(s) in which they were undertaken in order to address specific questions related to biosphere reserve management and for the implementation of the management plan (please refer to variables in Annex I). (For each specific topic provide reference citations. Provide the full citations alphabetically by lead author at the end of section 6 or in a separate annex).

Research and monitoring topics are diverse but many related to BR management. Major research themes include:

Wildlife population dynamics:

- Wolves
- Grizzly bears
- Caribou
- Dall's sheep
- Meso-carnivores (lynx, marten, coyote, wolverine)
- Snowshoe hare
- Small mammals

Geology:

- Geohazards (BR/Park Road)
- Permafrost
- Carbon sequestration
- Paleontology
- Glacier dynamics
- Fluvial geomorphology

Climate:

- Extensive array of station throughout the many climate zones in the BR
- Climate Reference Network station in the heart if the BR
- Stream gages

Archeology

- Prehistoric and historic sites
- Historic structures

Anthropology and other Social Sciences

Specific to the Denali Resource Stewardship Strategy, many resource monitoring and research projects have taken place in Social Science:

1. Integrated study of Park Road capacity:
    - Monitors traffic levels using counters at various locations along the road.
    - GPS data on movements of vehicles on the park road
    - SLCD panel data on bus wildlife sightings and hiker drop-off and pick-up locations
    - Staff monitoring of crowding levels at rest stops, wildlife viewing stops, and viewsheds
    - Research targeting visitor perception and experience via SOLVES framework
2. Backcountry monitoring:
    - Informal trail and campsite disturbance (vital sign)
    - Evidence of modern human use/ modifications (Vital sign)
    - Litter and human waste
    - Natural sound disturbance (vital sign)
    - Climbing, overnight, and day-use statistics of human access
    - Aircraft noise/fly overs and landings monitoring (outside designated core area of Biosphere Region)
3. Entrance area of the park, transition zone of biosphere indicators and standards development. Research projects with cooperating university and staff researchers in developing a baseline of soundscape, visitor experience, visitor access and impact standards.
4. Furbearer trapping management - sustainable trapping program for Biosphere transition zone communities such as Cantwell, Nikolai,



NPS/KENT MILLER

The Denali BR integrates traditional ecological knowledge into its prorams and management.

5. Wildlife population and harvest data (vital sign): community surveys and registration of permit hunts.

6. Record management of subsistence customs, traditions and social structure:

   - Subsistence fisheries monitoring
   - Cooperative harvest monitoring programs
   - Cantwell ORV EA implementation and restoration programs

7. Human population monitoring via census data and community surveys (vital sign)

8. Economic Impact Model:

   - Tourism indirect and direct economic effects tracing
   - Effects of fee pricing on potential visitor access - social exclusion study
   - Revised local economic diversification indicator

There have been nearly 300 research projects (research list attached) in the core zone, managed use area, and transition zones since 2001 resulting in several publications. We currently manage science publications within the Integrated Resource Management Application (IRMA). Currently there are 6,394 documents accessible for downloading; more are being added every day to address a backlog of information to be accessible to all people.

6.3 Describe how traditional and local knowledge and knowledge from relating to management practices have been collected, synthesized and disseminated. Explain how such knowledge is being applied to new management practices, and how and if it has been integrated into training and educational programmes. ("formal" – schools, colleges, universities, and "informal" services for the general public) that are active in the biosphere reserve? Describe their programmes, including special school or adult education programmes, as these contribute towards the functions of the biosphere reserve. Comment on organizational changes (if any) in institutions and programmes that were identified in the biosphere reserve

NPS/NATHAN KOSTEGIAN



Many Denali programs engage youth in science and conservation work.

ten or so years ago (e.g., closed down, redesigned, new initiatives). Refer to programmes and initiatives of UNESCO Associated Schools networks, UNESCO Chairs and Centers where applicable.

The BR's science team integrate traditional ecological knowledge (TEK) into assessing the wildlife populations in BR managed use area and transition zones by querying subsistence users. Regular communication and visitation is key to the success of TEK integration, as well as official validation of the TEK to the people that have shared it. One example is the place names project. We integrated Athabaskan knowledge and identity of Denali, its origin stories, history into educational programs. This not only deepened our education outreach to local communities and visitors, but also granted our scientists knowledge of what other sites in the BR are/have been important to people in the past, and need to be monitored for archeological resources and assessed for change. In the future, the Denali BR may connect youth from the Cantwell, Nikolai, Lake Minchumina, and Healy via the Tri-Valley School to the UNESCO Associated Schools Programme. UNESCO ASPnet would provide valuable cross-cultural experience in promoting peace and stewardship of the earth for local youth, and especially validate the traditional knowledge young Native students still acquire through their parents and grandparents. This cross-cultural sharing would bridge a growing gap in international understanding and peace, highly relevant to the success of preserving Biosphere Regions and other unique places.

We engage local youth through the Youth Civilian Conservation Corps (YCC) Program. The YCC is a modern culmination of a conservation, artisan, and service-learning program originally developed during the 1930s under the former president F. D. Roosevelt. Reinvigorated under President Obama, the YCC employs youth from communities that surround national parks and other public lands to work for a summer in conservation projects, science, and service. This program provides invaluable experience and growing opportunities for local youth of the BR, and gives especially underprivileged youth, an opportunity to refine skills they need for the future, as well as earn income and respect. The wider YCC Network. Currently operating in every state and the District of Columbia, Corps annually enroll more than 27,000 young men and women in service every year. Since its creation in 1985,

the Corps Network has provided national leadership and promoted the growth and quality of its member corps as they provide education, workforce development, and an ethic of stewardship to diverse youth who address important community and conservation needs.

We also engage young adults in the Student Conservation Association (SCA) Program. These young adults come from across Alaska, primarily minority students, to be interns for a summer in the Denali BR. Here they work with scientists, rangers, trail crews, and the dog kennels to gain valuable experience while exploring and working for, the biosphere. SCA is propelled by the passion of today's youth as they protect our environment and pave the way for a more sustainable planet. This is where the United States' conservation service movement started more than a half century ago, and SCA remains the best access to a potent force of tens of thousands of dedicated young stewards. In addition to caring for our most celebrated landmarks, SCA members protect endangered species, restore ailing habitats and enhance the experience of millions of park visitors each year. In 2015, for example, the SCA engaged 8,567 volunteers in 4,607 community service projects, as well as 3,960 field programs, amounting to 1.5 million hours of volunteer service. The SCA encompasses youth programs (for volunteers between 15-18 years of age), young adult programs (18+ years of age), Gap year programs, designed specifically for high school graduates who wish to do service work for a year, and Field leaders (21+ years of age) which are paid positions that lead conservation crews and projects.

SCA is highly valuable for the BR as it is the conservation service partner of choice, largely because its unique ability to bridge these two areas to leverage available support and maximize impact. SCA, the program, and SCA interns alike connect resource management agencies, philanthropic foundations, individual donors and sustainable businesses to benefit our land, our youth and our future.



NPS

The Student Conservation Association provides internships that give young people valuable experience for starting science careers.

For general visitor education, and local engagement with the Biosphere Region, we have the following:

Informal Interpretation consists of spontaneous (not scheduled) interpretive contacts with visitors within the park. These contacts may occur in a variety of settings, such as historic structures, natural features, overlooks, etc. This category includes both stationary and roving interpretation.

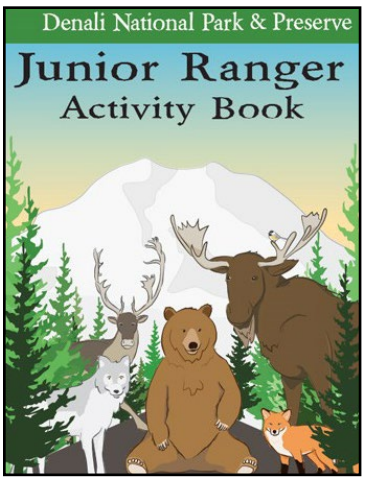
Formal Interpretation are all on-site, pre-planned presentations that have a goals themes, and objectives with desired measurable outcomes. They are designed to provoke visitors to form their own intellectual or emotional connections with the significance of the park resource. These programs are advertised, scheduled, or announced prior to being presented.

The BR also has an extensive Junior Ranger Program that targets youth. These youth participate in education programs about science and nature, complete an activity book, and promise to be a good steward of

NPS/KENT MILLER



A young Junior Ranger takes his oath upon completing the course.



the environment, and to live lightly on the land. The Junior Ranger Program is for young visitors who are interested in learning about the wildlife, wilderness, and people of Denali. The Junior Ranger Program is designed to be completed cooperatively with parents or other adults and is a great way for families to discover Denali together.

A system for distance learning opportunities, engagement with the Biosphere Region and Biosphere Region staff directly: https://www.nps.gov/dena/learn/education/index.htm. Teachers can sign up for classes of any ages through our distance learning programs.



Additionally, the Every Kid in a Park Program allows every fourth grader and their family to visit Denali BR for free. Primary school and higher teachers can sign up for classes of any ages, but we have a special program for fourth graders called Find Your Park: Denali.

The BR also provides adult education programs through the MSLC and AK Geographic partnership. These opportunities are primarily Field seminars with local scientists, visiting researchers, or BR community leaders. Examples from field seminars in 2015-2016 can be found here: https://www.nps.gov/rlc/murie/education.htm; and include (among many others): Composers in the Wilderness, Birds of Wonder Lake, Winter Ecology, Wildflowers of Denali, Climate Change: Seeing, Understanding, Teaching, and Landscape Painting.

6.5 How do you assess the effectiveness of actions or strategies applied? (Describe the methods, indicators).

Effectiveness measures are aided greatly by the current high-quality monitoring and research efforts at Denali; the high degree of integration of the BR's resource stewardship with the Central Network Inventory and Monitoring Program. The Denali Resources Stewardship Strategy (see Annex IV) has over 100 measureable indicators of the state of

the BR natural and cultural resources. Many of these indicators have defined standards. Regular visitor surveys conducted about every five years to assess the adherence of BR management to the Backcountry Management Plan and other aspects of the BR's mission. When indicator measures fall below standards management actions are considered.

Effectiveness of educational efforts is measured qualitatively and in real time. Interactions with individuals and groups have a discussion at the end of their time together to gauge effectiveness - adaptation in programming occurs for the next session. Periodic reviews of overall program occurs annually and adjustments are made when necessary.

6.5.2 Is there a biosphere reserve website? If so, provide the link.

There is not a specific website for the Denali BR as of yet, but the BR is highlighted in the pages of the Denali National Park and Preserve website, here: Denali Website. However, Denali is in the process of developing a website proper for specifically the BR, so BR communities can directly contribute to, enhance, the Denali BR webpage. This will effectively increase local stake in the BR, as it is bigger than the National Park both spatially and politically.

6.5.3 Is there an electronic newsletter? How often is it published? (provide the link, if applicable).

Yes. *Alpenglow* (winter season, summer season), Annual Science Updates (annually), and *Alaska Park Science* (bi-annually).

6.5.4 Does the biosphere reserve belong to a social network (Facebook, Twitter, etc.)? Provide the contact.

Denali BR belongs to :

Facebook: https://www.facebook.com/DenaliNPS/

Instagram: https://www.instagram.com/DenaliNPS

YouTube: https://www.youtube.com/USer/DenaliNPS

Flickr: www.flickr.com/photos/DenaliNPS

Twitter: https://twitter.com/DenaliNPS

iNaturalist: www.inaturalist.org/projects/2016-national-parks-bioblitz-denali-arthropod-inventory

And, Map of Life: www.mapoflife.org/projects/Denali

6.5.5 Are there any other internal communication systems? If so, describe them.

The host of the BR has an internal intranet website for employee information, updates and operating procedures.

The host of the BR is also linked to the Alaska Region intranet, and the national Department of Interior (DOI) intranet.

6.6 Describe how the biosphere reserve currently contributes to the World Network of Biosphere Reserves and/or could do so in the future.

Please refer to section 6.6.1

6.6.1 Describe any collaboration with existing biosphere reserves at national, regional, and international levels, also within regional and bilateral agreements. Biosphere reserve status is the foundation of our sister park relationships – twinning. (See also Section 8.7)

Key Points/Current Status:

We are advancing conservation and the long-term protection of the resources of the Denali BR on several fronts.

- Engaging with International Union for the Conservation of Nature via the NPS international office, and directly with BR staff volunteers for the IUCN.

- Department of the Interior International Technological Expertise Exchange Programs

- The BR is expanding relationship with Mt. Everest National Park in Nepal through staff exchange programs and sharing best practices for sustainable and sanitary mountaineering operations.

- Advancing Conservation in Circumpolar Region through shared science with Environment Canada on atmospheric mercury monitoring.

- Advancing our understanding of technology and creative outreach through staff exchanges.

- Advancing our ability to conserve migratory species through science and monitoring.

- Advancing our ability to engage youth through science by sharing youth science programming.

Next Steps include:

- Connect with Natura 2000 Program in polar regions

- Expand cooperation within the CESU framework (see section 2.2)

- Expand opportunities for cooperation with cross-border protected areas to the east of the Denali BR (with Canada)

- Expand opportunities for cooperation with cross-border protected areas to the west of the Denali BR, Beringa (with Russia).

- Establish a cooperative network of preserves through which migratory birds of Denali pass through going to South America – connect with South American preserves to be "Sister Parks" of Denali.

- Establish a cooperative network of Alaska and Canadian Parks and preserves that link to Denali BR's transition zones, in order to bridge over 12 million hectares of protected land for movement of wildlife and humankind through high functioning ecosystems.

6.6.2 What are the current and expected benefits of international cooperation for the biosphere reserve?

Please refer to section 6.6.1

6.6.3 How do you intend to contribute to the World Network of Biosphere Reserves in the future and to the Regional and Thematic Networks?

In addition to section 6.6.1 there are additional opportunities to create alliances among other reserves to highlight conservation and sustainable development. The Denali BR will seek to build new relationships with other BRs in the circumpolar north. Managing terrestrial ecosystem for connectivity, sustainable development, and tackling issues associated with climate change adaptation are shared challenges in the world network of the UNESCO BRs. Denali seeks to further a network of understanding, communication and conservation on these fronts.

6.7 What are the main factors that influenced (positively or negatively) the success of activities contributing to the logistic support function? Given the experiences and lessons learned in the past ten years, what new strategies or approaches will be favored as being most effective?

Key factor: Positive relationships, particularly as expressed through partnerships and agreements, particularly youth engagement initiatives are the most important factor.

6.8 Other comments/observations from a biosphere reserve perspective.

None at this time.



NPS/DENALI EDUCATION CENTER



Section 7. Governance, Biosphere Region Management, and Coordination

Members of the Denali BR communities of Healy, Cantwell meet to discuss important programs the Denali Education Center would offer in 2016, and raise money to help support the BR partner organization.

Biosphere Region coordination/ management coordinators/managers have to work within extensive overlays of government bodies, business enterprises, and a "civil society" mix of non-governmental organizations and community groups. These collectively constitute the structures of governance for the area of the biosphere reserve. Success in carrying out the functions of a biosphere reserve can be crucially dependent upon the collaborative arrangements that evolve with these organizations and actors. Key roles for those responsible for the biosphere reserve coordination/management are to learn about the governance system they must work within and to explore ways to enhance its collective capacities for fulfilling the functions of the biosphere reserve.

We have a strong and active presence in civil society, and this mutual participation in the civic sphere with other government, non-governmental, Native, private, and business enterprise entities works well for the management and coordination of the BR. Specifically we have:

- Consultation with tribal governments (including: Nikolai Edzeno Council, Telida Council, Ingalik Council, Tanana

Council, and Koyokuk Council – see: www.aaanativearts.com/alaskan-natives/alaska_tribal_councils.htm)

- National Environmental Policy Act (NEPA) and public involvement through scoping meetings and review
- Collaborative Events and planning (Earth Day with upper Susitna Valley communities, Winterfest with Denali Borough, Summer Art Festival with the City of Fairbanks)
- Doyon/ARAMARK Joint Venture, University of Alaska-Anchorage, University of Alaska-Fairbanks, Upper Susitna Soil and Water Conservation District)
- Through the concessions contract, commercial partners are encouraged and in some cases request certain activities and practices that support conservation and sustainability (e.g., quieter and more energy-efficient buses, elimination of single-use plastic water bottles, concessionaire's environmental management team)
- Subsistence Resource Commission for Denali meets semi-annually and addresses contemporary subsistence resource management issues
- Semi Annual meetings with the local Denali Borough Government
- Semi Annual meetings with the Upper Nenana Associated Chiefs Native Council.

7.1 What are the technical and logistical resources for the coordination of the biosphere reserve?

The Denali BR managers have several resources available to enhance engagement with the myriad of government and non-government entities that influence the effectiveness of the BR. In particular, the National Park has an External Affairs Department that has a manager and a public information team. The capacity of these employees are committed creating and fostering synergistic relationships, sharing information, hosting multi entity events, and building an environment of trust and understanding with the BR's stakeholder communities.

There are several different interest groups that use the BR managed use area, including the Alaska Geographic Field Institute, the Denali Education Center, a diversity of for profit businesses (transportation services, food vendors) and in-holders (private residences). Within the areas of partnership and cooperation there are local and state governments, businesses, towns, mines, and residents. For the better and more effective development, there are a number of coordination institutions/mechanisms to provide technical and logistical support:

- For the technical coordination, under the premise of giving priority to protection, in the framework of authorities provided by the U.S. Congress, laws, regulations, programs and policies, there are public processes legally expected by each Authority to coordinate and solve major issues in the principle of mutual benefit to stakeholders.
- For logistical resources, there are many including: Government agencies, a learning center, universities, community volunteers, and environmental associations in community groups such as the Denali Citizens Council, National Parks Conservation Association, and The Wilderness Society.

7.2 What is the overall framework for governance in the area of the biosphere reserve? Identify the main components and their contributions to the biosphere reserve.

Denali BR is under the National Park Service governing body and framework of the U.S. Department of the Interior. Figure 7.2 graphically represents this structure. The BR

follows National Park Service's Management Policies (2006) that describe the laws and policies tied that are derived from the NPS Organic Act of 1916.

We have modified our representation of the Biosphere Region form and functions as provided for in the statutory framework, article 4, section 5 where the emphasis is on "…functions, through appropriate zonation…" We further defined functions, through appropriate zonation per article 2, section 3 of the statutory framework, which specifies "individual Biosphere Regions remain under the sovereign jurisdiction of the states where they are situated. Under the present statutory framework, states take the measures that they deem necessary according to their national legislation."

Per the United States Congress and the laws and policies that govern U.S. soil, there is a specific expectation of sovereignty such that individual private property rights, and those authorities of states and the federal government, remain with such authority and independence that the primary legal way in which to implement the Biosphere Region concept is through agreements. It is this first key concept which is "deemed necessary" to address aspects of zonation and in Denali's case, provide for our areas of partnership and collaboration, which we term the Biosphere Region's transition zone. Furthermore, voluntary agreements cannot legally abdicate authority to a different management authority or to a collaborative decision body, such as a Biosphere Region governing board. Each member of the agreement retains its respective authority. Thus, agreements serve to formalize the issues or topics in common to each institution on which they wish to partner, so they may collaborate and share resources across boundaries. Denali BR currently has several such agreements.

These facts may confuse many outside the United States who may be familiar with landscape initiatives such as: Yellowstone to Yukon; Greater Yellowstone Coordinating Committee, Landscape Conservation Collaborates; National Park Service Inventory and Monitoring Networks, etc. These groups reflect agreements to encourage voluntary coordination and collaboration, akin to the aforementioned legal structure, and in no way represents an authoritative governance structure for that region or yields individual sovereignty.

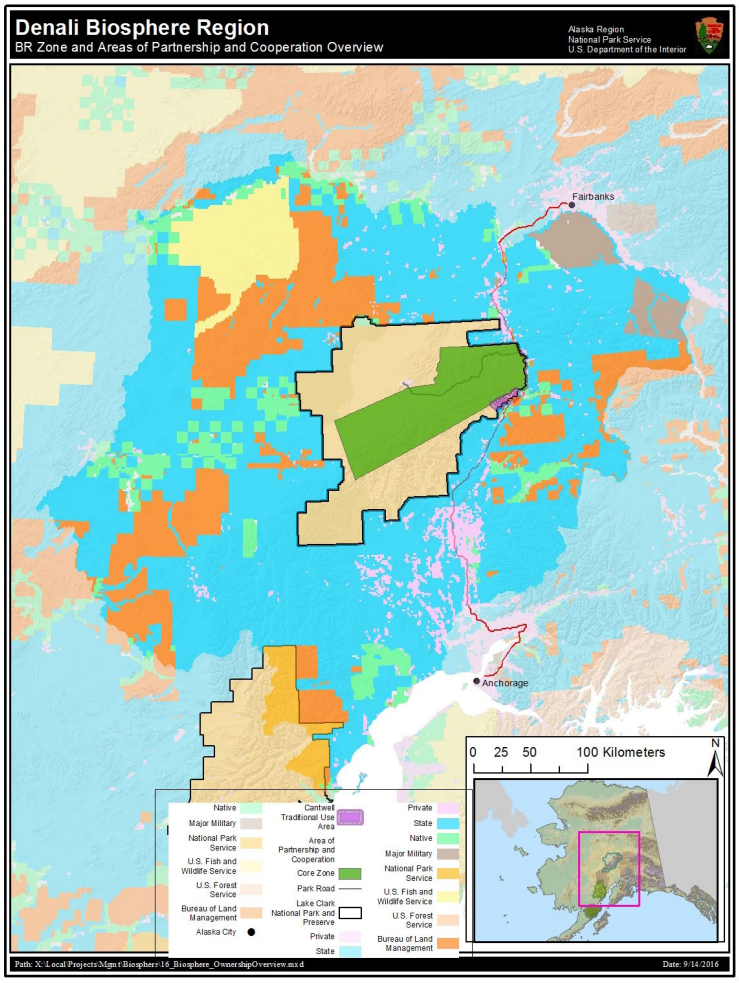


Figure 7.1. Denali Biosphere Region Areas of Partnership and Cooperation in Governance.

The second key concept relates to actually effectively managing in a sustainable way by addressing issues at the appropriate scale. Per article 4, section 5c of the statutory framework, the BR should include "an outer transition area where sustainable resource management practices are promoted and developed." To this end, the reality of actually managing in a sustainable way demands working at different scales for different issues. For example, at a macro scale we work with the lower 48 states and Central America on migratory species; at a micro scale we work with the State of Alaska to manage wildlife for sustainable harvest in the BR's managed

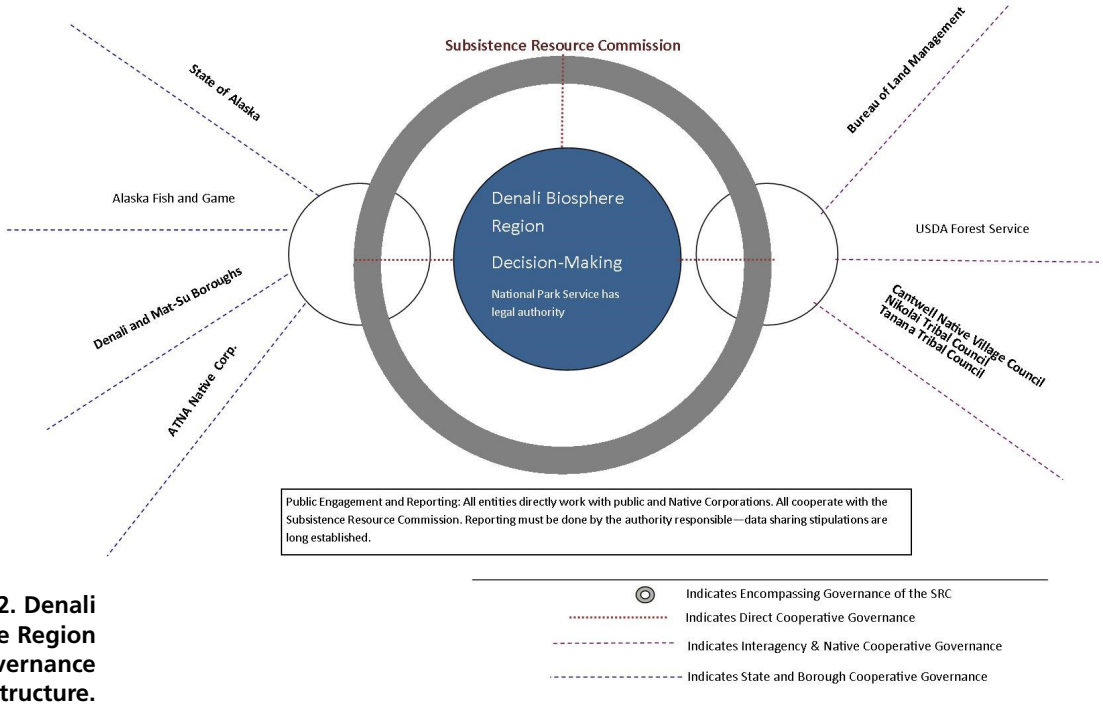


Figure 7.2. Denali Biosphere Region Governance Structure.

use area and transition zones. We also work with the State of Alaska to implement best management practices to improve air quality (Alaska Department of Environmental Conservation 2016). At a fine micro scale we work exclusively within a small, 250-meter section of mined river to restore hydrological functions and biological diversity. Therefore, we identify two transition areas to address different sustainability issues–the managed use area within the BR and the transition zone beyond the BR for resource management with the State of Alaska and particularly with the Alaska Department of Fish and Game.

In conclusion, Biosphere Regions within the United States will have at least two key components to zonation; (1) an area (or zone) that has an explicit legal authority provided for in law, and (2) agreements that are the legal instruments that connect authorities in a common cause. Finally, agreements most often are developed around issues in common and can be focused on one issue of collaboration, or many, depending upon interests and capacities of the organizations involved.

7.3 Describe social impact assessments or similar tools and guidelines used to support indigenous and local rights and cultural initiatives (e.g., CBD Akwé:Kon guidelines, Free, Prior, and Informed Consent Programme/policy, access and benefit sharing institutional arrangements, etc.).

Fundamental to addressing issues in the BR, and required by law, is the consultation with indigenous villages of Cantwell, Telida, Nikolai, and Lake Minchumina, all within the BR's transition zone and area of Partnership and Cooperation. Village members harvest within the BR managed use area and transition zone, due to their traditional subsistence lifestyle. The Native councils' knowledge of the BR is passed down through generations of storytelling and practice; understanding their perception and experience of the BR ecosystems is invaluable in the adaptive management strategy of the BR. Additionally, the semi-annual meetings of the Subsistence Resource Commission bring local issues of subsistence use, resource degradation or change to the forefront of the management of the BR; thus the subsistence villages have direct stake in the policies and decisions of the BR.

Additionally, the National Environmental Policy Act (NEPA) was passed by the U.S. Congress in 1969 and established *a national policy of encouraging productive and enjoyable harmony between human beings and the environment for present and future generations*. To further this policy, NEPA requires federal agencies like the NPS to evaluate the environmental impacts of its actions and to involve the public and indigenous peoples in the decision-making process. Within the NPS, the NEPA process is an essential tool for ensuring informed decisions that conserve resources, biodiversity and values. The NEPA process is intended to, "help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment" (CEQ 1500.1). The stated purposes of NEPA (42 USC 4321) is to create a national policy which will encourage productive and enjoyable harmony between man and his environment. NEPA requires the use of an "interdisciplinary approach" in planning and decision-making (sec. 102(2)(A)). This interdisciplinary approach is meant to ensure that information from a variety of appropriate disciplines, including the natural and social sciences and cultural resources, is integrated into the analysis and decision-making process (1502.6). Within the BR, the NEPA process often results in projects that incorporate a strong adaptive management paradigm where the effects of management actions are monitored. If desired outcomes are not achieved or unintended consequences are detected, then a cycle of reassessment is initiated (Figure 7.3). NEPA, partnerships, and traditional ecological knowledge shared with BR management through discussions and involvement from Native Councils allow for the adaptive management strategy of the BR to be successful.

The NPS has Director's Order 12 (DO-12) and its accompanying handbook set forth the policies and procedures by which the NPS meets its NEPA requirements.

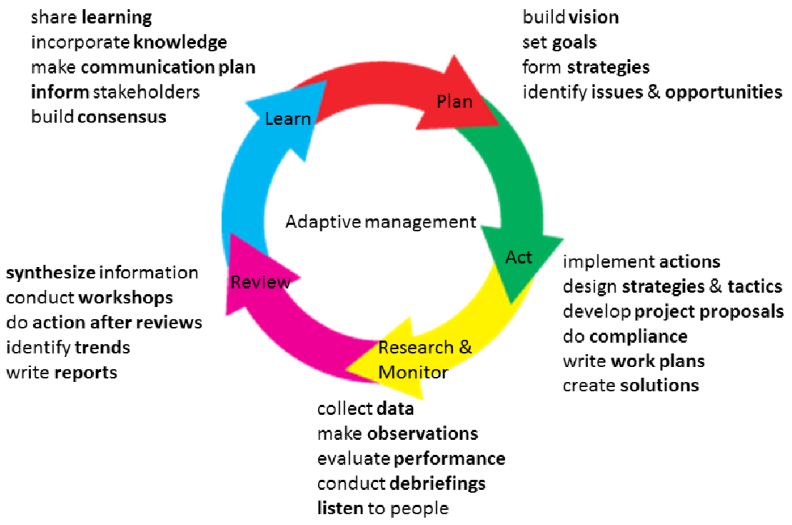


Figure 7.3. Adaptive management cycle of assessment.

7.4 What (if any) are the main conflicts relating to the biosphere reserve and what solutions have been implemented?

While from an ecosystem perspective, the BR's core zone, managed use area, and transition zone function well in conserving biodiversity (as described above), wolf management just outside the BR managed use area (within the area of Partnership and Cooperation) is controversial. In particular, the opportunity for visitors to see wild wolves along the Denali Park Road is affected by wolf hunting and trapping along the BR's north east boundary (the Stampede Corridor). A recent published study demonstrated that during years when wolf harvest in the Stampede Corridor was eliminated (due to a regulation sanctioned by the Alaska Board of Game) visitors were twice as likely to see wolves compared to years when the buffer was not in place. In 2010, the buffer was eliminated and viewing rates went from a high of 40% to 5% in 2015, due to the harvest of key pack members. BR managers will continue to work with the Alaska Board of Game to have the no harvest buffer reinstated, but local hunting and trapping interest are generally opposed to any restrictions.

Scenic flight seeing (air tours) are a popular way for visitors to experience the BR's vastness

NPS/KELLER



View from BR Managed Use Area, to the expanse of the Transition Zone, looking East.

and inaccessible glaciated terrain. Visitors that invest great physical effort to engage in multi-day backpacking trip to experience the BR's wilderness often complain that the adventure and solitude they seek is fractured by the noise of the small aircraft used for air tours. The BR has specific soundscape standard for the backcountry (Betchkal 2013) but these have been impossible to achieve because airspace above the BR is not controlled by the National Park Service or any other government entity apart from the Federal Aviation Authority (FAA). Between 2006 and 2014, the BR held a series of stakeholder meetings with aviators, and backcountry advocates (Withers and Adema 2009). This Overflights Advisory Group published a set of voluntary aviation best practices for air tour operators. Most flights now follow these recommendations and a small improvement in backcountry aviation noise has been observed. However, the soundscape standards are still not being met and more work will be required in the future to resolve this issue. The BR's framework provides an opportunity to engage, rather than to direct, private enterprises in their cooperation to preserve the quiet and solitude the BR has to offer its mammals, fish, birds, and human species.

7.4.1 Describe the main conflicts regarding access to, or the use of, resources in the area and the relevant timeframe. If the biosphere reserve has contributed to preventing or resolving some of these conflicts, explain what has been resolved or prevented, and how this was achieved for each zone?

With more than 500,000 visits a year and only a few thousands residents in the surrounding areas there are a diversity of small conflicts that arise regarding competing business and interests, but also as many opportunities. In addition to wolf management and aviation noise described above, another example is the use of off-road vehicles (ORVs or quads) for moose hunting in a portion of the transition zone.

The residents of Cantwell, one of the BR's resident zone communities, requested the BR allow the use of all-terrain vehicles (ATVs) for subsistence moose hunting. BR managers are only authorized to allow for ATVs if the activity was determined to be traditional prior to the 1980 establishment of the managed use area and transition zone. Much social science research was conducted and a determination made that ATVs for subsistence was traditional. However, vegetation impacts to meadow communities were significant. Therefore a sophisticated approach was designed and presented in the 2006 Cantwell

ORV Environmental Assessment. After a rigorous public process, regulations were adopted allowing ORV in limited portions of the Cantwell Traditional Use Area (TUA), within the transition zone, for subsistence hunting while the remaining portion of the TUA is open to non-motorized hunting. While the debate over motorized access to subsistence hunting ground continues, this EA and the associated regulation generally honors the rights of subsistence users and protect sensitive plant communities.

7.4.2 Describe any conflicts in competence among the different administrative authorities involved in the management of the area comprising the biosphere reserve.

There are no conflicts in competence among the different administrative authorities. Agreements with administrative authorities outline processes for addressing issues as well as areas of common interest to focus. Differences in mandates can be vetted and potentially resolved within existing and well understood administrative processes.

7.4.3 Explain the means used to resolve these conflicts, and their effectiveness. Describe its composition and functioning, resolution on a case-by-case basis. Are there local mediators; if so, are they approved by the biosphere reserve or by another authority?

Each person and organization has access to the full complement of conflict resolutions tools–from facilitators to State and Federal Court system. The agreements by which different entities relate to each other, such as the general agreement between the NPS, the Borough, and the State of Alaska, generally identify internal conflict resolution mechanisms. Public workshops, hearings, and planning processes provide other mechanisms by which conflicts can be identified, discussed, and often addressed. Mediation processes can be overseen by agencies or by local governments. Decision-making processes at site, local government, and agency levels bring discussion about conflicts to closure and initiate actions. The court systems and legislative bodies provide the ultimate authorities for resolving conflicts in an orderly and procedural manner when other methods fail.

7.5 Updated information about the representation and consultation of local communities and their participation in the life of the biosphere reserve:

7.5.1 Describe how local people (including women and indigenous people) are represented in the planning and management of the biosphere reserve (e.g., assembly of representatives, consultation of associations, women's groups).

Legislation unique to Federal land management entities in Alaska require the formation of local Subsistence Resource Councils (SRC) that advises BR managers on subsistence issues. The Denali BR maintains a SRC with membership from all the local communities that are authorized to harvest resources within the managed use area and transition zones. The SRC meet with BR managers twice per year.

As described in section 7.3, the NEPA process and the requirement to include public representation includes all members of the public, including women and indigenous people, not just within the BR, but within the United States of America. Citizens can participate as individuals or as members of an organization, of any kind. We ensure local representation occurs through public outreach, meetings, social media and direct correspondence. Grassroots involvement is easily accommodated.

7.5.2 What form does this representation take: companies, associations, environmental associations, trade unions (list the various groups)?

Representation can take many forms. Examples of our stakeholder groups include the following (See Annex II, Appendix C for full list):

Alaska Department of Fish and Game

Denali Citizens Council

The National Parks Conservation Association

The Denali Chamber of Commerce

Denali Education Center

The Alaska Travel Industry Association

The Tri-Valley School District

7.5.3 Indicate whether there are procedures for integrating the representative body of local communities (e.g., financial, election of representatives, traditional authorities).

The BR provides access for local representation through public outreach meetings, social media, and direct correspondence. Opportunities exist for individuals to voice their opinions through written and oral comment at the local, regional and national level of the executive branch of government and also to the legislative branch–local, regional, state and national elected officials. Any individual who meets age requirements is eligible to stand for election to any elected body of government; there is no financial eligibility test. Native villages and councils establish their own sovereign procedures for electing tribal leaders that may include recognition of traditional authorities.

7.5.4 How long-lived is the consultation mechanism (e.g., permanent assembly, consultation on specific projects)?

The primary consultation mechanism is permanent as reflected in the 1969 public law, the National Environmental Policy Act (NEPA). The duration established for consultation on any specific project is determined by the characteristics of the project and the nature of the decision that is to be made. Each action will have a different level of public engagement depending upon the size, scope and relative impact of a proposal. The process also requires the federal government to consult with tribal entities on a government to government basis. The NEPA process can take up to a few years to result in a decision on a proposed action.

In other cases, issues are resolved through the ballot box, in which cases specific procedures and timetables are prescribed and followed.

7.5.5 What is the impact of this consultation on the decision-making process (decisional, consultative or merely to inform the population)?

The NEPA process is required by law to consider all the environments and socio-economic effects of the proposed action(s) under consideration. Decision makers are required to integrate public input on relevant factor into the final record of decision. In situations where public input was not given adequate consideration or the NEPA process was not followed correctly, courts often require managing agencies to restart the NEPA process. Denali National Park and Preserve has engaged in over 100 NEPA actions in the past 20 years without the public requesting judicial review. A record of the current and past BR's NEPA processes can be found on the NPS's Planning, Environment, and Public Comment web portal.

Each of the agencies described in the present report are public service organizations. As such, members of the public as well as cooperating agencies (including the partner agencies described through the existing agreements with U.S. Forest Service and the Alaska Department of Fish and Game), can have significant influence over decision outcomes. This influence, achieved through NEPA, or related processes, reflects input by the public.

For the core zone and managed use area, the National Park Service has the decision authority, as prescribed in law and policy. The NPS and Alaska Department of Fish and Game share the decision authority over wildlife and resources within the transition zone. The Alaska Department of Fish and Game and BLM share the decision authority over the use of fish and wildlife resources within the Area of Partnership and Cooperation.

7.5.6 At which step in the existence of a biosphere reserve is the population involved: creation of the biosphere reserve, drawing up of the management plan, implementation of the plan, day to day management of the biosphere reserve? Give some practical examples.

The people, through their elected officials, are involved in every step of protected area creation, and management planning. Citizens often join advocacy groups that are tasked with lobbying elected officials to create specific protected area. Mt. McKinley National Park was created by an act of Congress after a decade long advocacy campaign by a few individuals concerned with the conservation of the region's wildlife resources. Major management actions are informed by the public NEPA process described in section 7.5.5. The day to day management and operations of the BR are the responsibility of the National Park Service. Because the foundation for management was established by a public process and guided by elected officials, the public is not involved in day to day management and operations. Denali BR has established a clear coordinated-management mechanism with various stakeholders or their representatives to achieve shared objectives.

7.6 Update on management and coordination structure:

Refer to section 7.6.1 and Table 7.2

7.6.1 Describe any changes regarding administrative authorities that have competence for each zone of the biosphere reserve (core area(s), buffer zone(s) and transition area(s))? If there are any changes since the nomination form/last periodic review report, please submit the original endorsements for each area.

No changes. However, clarification of how the National Park's administrative zones, as described in law, perfectly fit the BR's zonation scheme is offered:

The Denali Wilderness functions as the BR's core zone. The wilderness is managed for natural process and conservation. No development, infrastructure, harvest, collection, or manipulations are permitted. Backcountry recreation is managed for low density use and solitude. Motorized travel is not permitted. Pets and camp fires are not permitted.

The Denali National Park Additions (New Park) function as the BR's managed use area. No development, infrastructure, or manipulations are permitted. Backcountry recreation is managed for low density use and solitude. Subsistence hunting and firewood harvest is permitted for federally qualified local residents. Fall season motorized travel is permitted for subsistence only by federally qualified local residents within the Cantwell Traditional Use Area, a portion of the managed use area. Winter motorized travel is permitted for traditional activities.

The Denali Preserves function as the BR's transition zone. No development, infrastructure, or manipulations are permitted. Backcountry recreation is managed for low-density use and solitude. Subsistence and sport hunting and firewood harvest is permitted under Alaska game regulations. Winter motorized travel is permitted for traditional activities. However, traditional activities have not yet been clearly defined thus snow machine use is prevalent during periods of good weather and snow conditions.

The State of Alaska's Game Management Units 20,19,16, and 13, consist primarily of undeveloped State and Federal lands outside the BR's political boundary and function as the transition zone. These lands are contiguous with the BR's core zone, and managed use area, and are managed to provide maximum sustainable yield of wildlife. Ecological process such as fish and wildlife movements, and wildland fire are not hindered by political boundaries or the low density of development in the region. Harvest pressure under State Management is higher than within the BR, and wildlife population are occasionally manipulated by predator control or liberalized harvest quotas for predators. This practice of "intensive management" is designed to increase the sustainable yield of

ungulate species for human consumption. However, these largely undeveloped lands span a large area and allow for viable linkages with other distant large protected areas. For example, wolves from Denali have been documents dispersing across hundreds of miles of the transition zone and successfully denning within another NPS protected area (Borg and Burch 2013).

7.6.2 Update information about the manager(s)/coordinator(s) of the biosphere reserve including designation procedures.

The managing and coordinating entity, the U.S. National Park Service, for the Denali BR has not changed since its designation.

7.6.3 Are there any changes with regard to the coordination structure of the biosphere reserve? (if yes, describe in details its functioning, composition and the relative proportion of each group in this structure, its role and competence.). Is this coordination structure autonomous or is it under the authority of local or central government, or of the manager of the biosphere reserve?).

There are no changes at this time. The coordination structure remains a voluntary partnership that draws on functions, competencies, and authorities of each of its partners.

7.6.4 How has the management/ coordination been adapted to the local situation?

The ability of the managing and partner entities to adapting to unique and emerging issues is key to the success and relevancy of any conservation unit. The Denali BR on-the-ground management has continuously adapted to changing physical and ecological conditions and the changing needs of stakeholders. Please see the Vehicle Management Plan (2012) (Annex II) for an example of a sophisticated methods of capacity management and see 7.4.1 for a detailed example of adapting to local concerns regarding motorized access to the BR's subsistence resources.

7.6.5 Was the effectiveness of the management/coordination evaluated? If yes, was it according to a procedure?

Effectiveness is evaluated at each stage of our adaptive management process. Some of the evaluations are qualitative; however, many are quantitative as described in Vehicle Management Plan (2012) and the Cantwell ORV Use EA, and in the Comprehensive Resource Stewardship Strategy. Short term actions driven by immediate needs are reviewed through an After Action Review process allows participants to engage in feedback and provide opportunity for future improvement.

7.7 Update on the management/ cooperation plan/policy:

7.7.1 Are there any changes with regard to the management/cooperation plan/policy and the stakeholders involved? If yes, provide detailed information on process for involvement of stakeholders, adoption and revision of the plan.

There are no changes at this time.

7.7.2 Describe contents of the management/ cooperation plan (provide some examples of measures and guidelines). Is the plan binding? Is it based on consensus?

The core, managed use area, and transition zone operate under a portfolio of management documents. The management documents tier of the Denali Foundation Statement (Annex II) which spells out the laws, key resources, etc. for which these areas operate. This Foundation Document is binding to the specific zones described. Foundation documents have replaced traditional park management plans as documents that are long-lived and used as a foundation in which to develop issue-driven plans. Key aspects of these documents are described the sections above. In fact, the various aspects of BR management discussed in this document directly tier of a plan or strategy contained with the portfolio. The documents in the portfolio are binding.

Per the detailed discussion in section 7.2 of this document, the agreements with BR partners are non-binding voluntary agreements to collaborate and share resources. They are specifically focused on improving the quality of activities in the transition zone so as to improve sustainable development and conservation of biological diversity.

7.7.3 Describe the role of the authorities in charge of the implementation of the plan. Describe institutional changes since the nomination form/last periodic review report. Please provide evidence of the role of these authorities.

The institutional relationships have not changed in nature but have gotten stronger and more diverse over the years since the original nomination. Please see section 7.2 for a detailed explanation.

7.7.4 Indicate how the management plan addresses the objectives of the biosphere reserve.

Please see section 7.7.2.

7.7.5 What are the progresses with regard to the guidelines of the management/ cooperation plan/policy?

The overall progresses with regard to the suite of management documents are numerous. A detailed example was described in section 7.4 of this document. This example is one of many agreements which range in complexity from the example given to rights-of-way for utilities. Together these agreements encourage actions that both protect biodiversity and encourage sustainable development.

7.7.6 Were there any factors and/or changes that impeded or helped with the implementation of the management/ coordination plan/policy? (Reluctance of local people, conflicts between different levels of decision-making).

Key to facilitating success with implementation is the National Environmental Policy Act. It clearly provides for a process that is inclusive and is able to address conflict. The many agreements also facilitate success by identifying common goals and desired individual and common actions to achieve those goals. While local conflict exists, it has diminished significantly since 1980 when additions to the BR were enacted.

7.7.7 If applicable, how is the biosphere integrated in regional/national strategies? Vice versa, how are the local/municipal plans integrated in the planning of the biosphere reserve? (Please provide detailed information if there are any changes since the nomination form/last periodic review report).

The NPS considers the entire National Park System and all 413 units part of the system of parks and protected areas. At the national level, efforts are continuously underway to identify new lands and opportunities to fill in the gaps in this system. At the local level partners agencies collaborate and integrate, for example Denali State Park is contiguous with the Denali BR.

To adhere to the people-oriented concept and harmonious development between people and the reserve; the reserve planning is prepared based on national, and state planning laws and regulations, local Borough policies, local Native Councils' direction and guidance, industrial policy, environmental policy thus ensuring harmony and mutual complementation.

NPS/JACOB W FRANK



Spring beauty of wildflowers in the park (*Claytonia sarmentosa*).

Section 8. Criteria and Progress Made

Conclude by highlighting the major changes, achievements, and progress made in your biosphere reserve since nomination or the last periodic review. How does your biosphere reserve fulfill the criteria. Develop justification for the site to be a biosphere reserve and rationale for the zonation. What is lacking, and how could it be improved? What can your biosphere reserve share with others on how to implement sustainable development into practice?

Brief justification of the way in which the biosphere reserve fulfills each criteria of article 4 of the Statutory Framework of the World Network of Biosphere Reserves:

8.1 Encompass a mosaic of ecological systems representative of major biogeographic region(s), including a gradation of human interventions. (The term "major biogeographic region" is not strictly defined, but it would be useful to refer to the Udvardy classification system.

As stated in sections 2, 3, and 4 in great detail, the BR contains a myriad of ecosystems ranging from lowlands less the 100 meters above sea level where salmon runs provide an input of nutrients and calories to BR fauna and flora where the climate is maritime, to lichen dominated alpine. As demonstrated in section 2, the population is 0 in the core zone and there are hundreds of people living in the transition zone, in total representing low population density spread over tens of thousands of hectares. However, populated zones are dense with inhabitants who must work together and cooperate to navigate the BR's managed use area and transition zones and enjoy its benefits. This dramatic continuum of population is across a mosaic of ecological systems (see Figure 3.1) results in a gradation of human interventions with extremes at both ends: Mining, sport hunting and subsistence hunting, to wilderness in the core zone with no extractive activities. All human use is monitored, evaluated for conservation and efficacy purposes; restorative actions are taken based on these evaluations.

8.2 Be of significance for biological diversity conservation.

As described in sections above, the BR is a rare example of an intact ecosystem with all the ecological systems components present and functioning. Thus, not only is biodiversity protected, the energy flow between system component and the geophysical underpinnings of these systems are also fully protected. Biological diversity conservation is fundamental to the BR and it remains one of the more pristine examples of sub-arctic boreal ecosystem in the world.

8.3 Provide an opportunity to explore and demonstrate approaches to sustainable development on a regional scale. (Including examples or learning experiences from putting sustainable development into practice).

The coordination of a shuttle system to address recreation movement from the local town to trailheads is a great example of innovation and application of sustainable development. Several of the facilities in the BR are LEED-certified for energy and water use efficiencies. The Zero Landfill Initiative aims to increase the rate of diverting waste away from landfills and into recycling streams. . Leave no trace training for backcountry users is required.

8.4 Have an appropriate size to serve the three functions of biosphere reserves.

The 3,024,525 hectares that encompass the Biosphere Region account for the protection of biodiversity including the migratory cycles of a key ungulate, the Denali caribou herd. When including the transition zone (18,032,453 hectares), opportunities for dispersal and migration are vast for all stages of life cycle wolves, bears, ungulates, and avian species. The vast landscapes provide ample opportunities for local residents to harvest subsistence resources. Future cooperation with surrounding national parks will only further enhance this connected vision for healthy, and wild, life cycles of Denali BR flora and fauna.

8.5 Appropriate zonation to serve the three functions.

In section 7 we delineate a set of areas and zones to address this. It functions as intended to address:

1. conservation - contribute to the conservation of landscapes, geophysical process, migration routes, ecosystems, species and genetic variation;

2. development - foster economic and human development which is socio-culturally and ecologically sustainable;

3. logistic support - support for demonstration projects, environmental education and training, research and monitoring related to local, regional, national and global issues of conservation and sustainable development.

8.6 Organizational arrangements should be provided for the involvement and participation of a suitable range of inter alia public authorities, local communities and private interests in the design and the carrying out of the functions of a biosphere reserve.

As explained in section 7, through the National Environmental Policy Act and the processes adopted to fulfill that law, any individual, representing any organization, can add substantive comment to a planning process and affect an outcome with the area of the Biosphere Region. This is specific to the authority of the National Park Service, and represent the core zone, and managed use area. That said, the other authorities that manage transitions zone along with the National Park Service, also embrace NEPA or its State-mandated analog. It is our intent to build on existing data sharing agreements and joint research initiatives with these areas of partnership and cooperation so we may better articulate their information in the future.

8.7 Mechanisms for implementation:

8.7.1 Mechanisms to manage human use and activities.

Each zone has discrete and distinctive authority as described through numerous laws and policies such as: the Organic Act, the Wilderness Act, the Alaska National Interest Lands Conservation Act (ANILCA), etc. Especially in the BR, management of human movement and impact in the BR is executed via the use of management plans, and associated permits. Activities that would cause some damage to the physical, biological, or cultural resources of the BR are rejected by the BR management team, until due process is taken to adjust and rectify these project plans to reduce impact. Activities that could result in impairment of BR resources are rejected.

8.7.2 Management policy or plan.

The core, managed use area, and transition zone operate under the plans contained in the Portfolio of Management Plans. Within the areas of partnership and collaboration agreements with collaborators provide clear shared goals and objectives.

8.7.3 Authority or mechanism to implement this policy or plan.

Authorities are clear per sections 7.1 and 7.2 and throughout section 7 of this document.

8.7.4 Programmes for research, monitoring, education and training.

Detailed research and monitoring activities and partnerships are described in section 6.

8.8 Does the biosphere reserve have cooperative activities with other biosphere reserves (exchanges of information and staff, joint programmes, etc.)?

8.8.1 At the national and regional level:

Regularly, the Denali BR shares staff, specialty expertise, and technology resources with the other BRs in Alaska (Noatak and Glacier Bay). We also benefit from the other Biosphere Regions within the Alaska Region of the NPS in a similar way. Resources are also shared within the NPS's BR at the national level.

8.8.2 Through twinning and/or transboundary biosphere reserves:

Biosphere Region status is the foundation of our future twinned protected areas/ reserves, sister park relationships within the International Union for the Conservation of Nature (IUCN), Natura 2000, and UNESCO MAB. We have very active connections with circumpolar protected landscapes, co-monitoring and learning from each other's experiences, especially regarding dramatic climate change; we share many of the same issues. The protected areas include a Biosphere Region. Please see section 6.6.1 for information regarding these active relationships: staff exchanges, science exchanges, shared data and workshops, and youth science.

8.8.3 Within the World Network:

Each year we have visiting professionals from several countries. These visits are often one to three days long in which we openly discuss both the challenges and opportunities of conservation. The MAB program connects U.S. quickly to each country's experience and we successfully use this connection to explore a diversity of issues.

8.9 Obstacles encountered, measures to be taken and, if appropriate, assistance expected from the Secretariat:

The primary obstacle has been finding a way forward for U.S. Biosphere Regions. The Secretariat, the Bureau, the ICC and Member States have been helpful to the U.S. in sorting out how to best accomplish a way forward, and for that we are grateful.

The difficult spot appears to be how the aforementioned groups will interpret section 7 of this document. We have done our best to articulate how we indeed have all three zones represented and a coordinated governance of those zones. It functions as intended by the statutory framework. However, section

7 documents how to accomplish this task, legally, and with good spirit of collaboration. We believe the NPS areas designated as BRs exemplify the path of sustainability for the U.S. and would do well to represent the network of Biosphere Regions.

8.9.1 Main objectives of the Biosphere Reserve. Describe the main objectives of the biosphere reserve integrating the three functions and the sustainable development objectives for the coming years.

Assuming the Denali BR's 1976 designation stands, we will move forward immediately on four specific efforts:

1. Improving our ability to understand and share information related to the Zone of Partnership and Cooperation (which is the transition zone) with the BR's Partners and communities. We learned through this experience the importance of being able to report out and collaborate across the entire region regardless of the managing authority. This effort will require U.S. to affirm existing, and form new, data sharing agreements.
2. Improving the brand of the BR. The authorities involved in the BR legally cannot advertise or market our brand, so too it is with the BR brand. However, there are creative ways in which we can elevate the brand and we will pursue opportunities to do just that.
3. Improving and expanding transboundary efforts to collaborate in developing and sharing research to understand the rapidly changing circumpolar Arctic and subarctic. In the near future, establish talks to build a cooperative network of national parks (Lake Clark, Katmai) and Canadian reserves along the Yukon for over 12 million hectares of interwoven protection.
4. Working with local governments, tribes, schools, and community leaders to make the BR more even more relevant and vibrant to the BR's neighbors.

Biosphere Objectives for Next 10 Years

1. Raise awareness of the incredible ecological integrity of the Denali Biosphere Region so that people know that they are living, working and recreating in a biosphere that connects people and nature in a global context.
2. Continue to govern the Denali Biosphere Region as a network of formal and informal partner networks that continually evolve to meet changing management needs.
3. Work with stakeholders to develop an engagement plan that includes branding to build relationships and social media in order to reach a diverse audience.
4. Strengthen the Biosphere's collaborative partnerships with the local school districts to transform existing programs that develop youth leaders, serve diverse and underserved communities, educate on climate change impacts, and promote health through use of park lands, to embrace the global biosphere context.
5. Continue to invite and facilitate a broad array social and ecological research within the biosphere reserve; identify research needs specific to the biosphere reserve and engage with local universities and land managers to meet these needs.
6. Continue to serve as a model for climate change adaptation, sustainable development and green operations, while re-framing our efforts as those of the Denali Biosphere and share our successes and lessons learned with the global community.
7. Enhance engagement with University of Alaska to elevate awareness of the importance of the Denali Biosphere Region and the global biosphere network.
8. Develop an informal twinning relationship with natural areas in other part of the world, that shares Denali's migratory bird species, to share best practices related to conservation, sustainable development, climate change adaptation, and community engagement.
9. Explore expanding the Denali Biosphere Region to establish a more cohesive Area of Partnership and Cooperation, including Lake Clark National Park and Preserve and adjacent protected and managed lands and waters.

NPS/KATIE THORESEN



The aurora borealis dances across the sky in early April.

Section 9. Supporting Documents

Annex I

Appendix A: MABnet Directory of Biosphere Reserves

Appendix B: Promotion Materials (Photos) for UNESCO MAB

Annex II

Agreements and Reports

Appendix C: Agreements list referencing the types of agreements in place

Appendix D: Research Program List referencing the past (to 2000) and ongoing research permits in the Denali BR

Appendix E: Species lists including common names of flora and fauna of Denali.

Appendix F: Denali BR Stakeholder list referencing established stakeholders

Appendix G: Denali BR Partnerships list referencing established partners

Appendix H: Agreement with Alaska Fish and Game

Appendix I: Agreement with the Bureau of Land Management and U.S. Fish and Wildlife Service

Appendix J: Agreement with the USDA Forest Service

Appendix K: Denali National Park and Preserve and Biosphere Reserve Foundation Document

Appendix L: Vital Signs Monitoring Plan

Appendix M: State of the Park Report 2012, published in 2016

Appendix N: Denali Subsistence Resource Commission Charter, the cooperative governance agreement within the Denali Biosphere Region

Appendix O: References, list of all cited references in Denali BR report

Annex III

Maps and Figures

Appendix P: Maps

Figure 2.2.2. A map of Denali Biosphere Region Zone Overview, highlights the boundaries of the core, transition zones, and managed use areas.

Figure 2.2.3. A map of Denali Biosphere Region Zones and Features, highlights zones, including unique features to the Denali BR, including the Cantwell Traditional Use Area.

Figure 2.3.8. A map of Denali Biosphere Region Athabascan Languages, highlights the Athabascan languages of the Denali BR.

Figure 3.1. A map of Denali Biosphere Region Land Cover, highlights the 25 different landcover classes within the Denali BR.

Figure7.1. A map of Denali Biosphere Region Areas of Partnership and Cooperation in Governance, highlights the different ownership of land parcels outside Denali National Park and Preserve proper.

Appendix Q: Figures

Figure 5.2. Tourism Trends in Denali Biosphere Region: 2000-2015

Figure 7.2. Denali Biosphere Region Governance Structure, highlights how the BR is organized and documents what will be reported in this Periodic Review.

Figure 7.3. Adaptive management cycle of assessment.

Table 1. MAB Criteria Summary September 2015, highlights how the U.S. adapts to the zonation language, as deemed necessary by law and regulation.

Annex IV

Other Agency/Entity Land Management Plans in Denali Biosphere Region

Appendix R: DOI BLM East Alaska Resource Management Plan

Appendix S: Denali Borough Land Management Plan

Appendix T: State of Alaska Department of Natural Resources Land Management Plan

Appendix U: Green Parks Plan

Appendix V: Denali Resource Stewardship Strategy



NPS/JACOB W FRANK

A Ranger conducts wintertime work by dog sled.

Section 10. Addresses

10.1 Contact address of the proposed biosphere region:

Denali Biosphere Region
Denali National Park and Preserve
PO Box 9
Denali Park, AK 99755
USA

Phone: (+1) 907 683 9532
Fax: (+1) 907 683 9612

Authors Contact Information:

Dave Schirokauer
Chief of Resources
Ph: +1907.683.9566
Email: dave_schirokauer@nps.gov

Dr. Rose Keller
Social Scientist
Ph: +1907.683.9572
Email: rose_keller@nps.gov

Denali Biosphere Region

Periodic Review Report, Annexes



Denali National Park and Preserve
National Park Service
Department of the Interior



ON THE COVER

A cow moose browses in a snowy patch of birch.
NPS/Tim Rains

ON THIS PAGE

A musher traverses Wonder Lake by dog sled.
NPS/Jacob W. Frank

Denali Biosphere Region

Periodic Review Report, Annexes



Authors

David Schirokauer

Dr. Rose Keller

National Park Service
Denali National Park and Preserve
PO Box 9
Denali National Park, AK 99755

September 2016

Table of Content

Page

ANNEX I. MAN AND THE BIOSPHERE ADMINISTRATIVE DETAILS....1

Appendix A. MABnet Directory of Biosphere Reserves....1

Appendix B. Promotion and Communication Materials for the Biosphere Reserve ..3

ANNEX II. AGREEMENTS AND REPORTS....5

Appendix C. Agreements List....5

Appendix D. Research Program List....6

Appendix E. Fauna and Flora Species List....15

Appendix F. Stakeholder List....61

Appendix G. Partner List....62

Appendix H. Agreement with Alaska Department of Fish and Game....63

Appendix I. Agreement with the Bureau of Land Management and U.S. Fish and Wildlife Service....70

Appendix J. Agreement with the USDA Forest Service....75

Appendix K. Denali National Park and Preserve and Biosphere Reserve Foundation Document....87

Appendix L. Vital Signs Monitoring Plan....87

Appendix M. State of the Park Report....87

Appendix N. Denali Subsistence Resource Commission Charter....88

Appendix O. References....91

ANNEX III. MAPS AND FIGURES....95

Appendix P. Maps....95

Appendix Q. Figures....100

Table of Content (*continued*)

Page

ANNEX IV. OTHER AGENCY/ENTITY LAND MANAGEMENT PLANS IN DENALI BIOSPHERE REGION.....103

Appendix R. DOI BLM East Alaska Resource Management Plan 103

Appendix S. Denali Borough Land Management Plan.....103

Appendix T. State of Alaska Department of Natural Resources Land Management Plan 103

Appendix U. Green Parks Plan 103

Appendix V. Denali Resource Stewardship Strategy.....103

ANNEX I. MAN AND THE BIOSPHERE ADMINISTRATIVE DETAILS

Appendix A. MABnet Directory of Biosphere Reserves

Annex I to the Biosphere Reserve Nomination Form, January 2013
Biosphere Reserve Description1
Administrative Details

Country: USA

Name of BR: Denali

Year designated: 1976[1]

Administrative authorities: (17.1.3)

Name Contact: Don Striker, Superintendent

Contact address:

Denali National Park and Preserve
PO Box 9
Denali National Park, AK 99755
Ph: +1907.683.9625

Related links: www.nps.gov/dena/

Social networks: (16.4.3)

Denali BR belongs to:
Facebook: https://www.facebook.com/DenaliNPS/

Twitter: https://twitter.com/DenaliNPS

and iNaturalist: https://www.nps.gov/dena/learn/news/denali-first-bioblitz.htm

www.inaturalist.org/projects/2016-national-parks-bioblitz-denali-arthropod-inventory

[1] To be posted on the MABnet once the nomination has been approved. The numbers refer to the relevant sections of the nomination form.

Description

General description: (Site characteristics in 11.1; human population in 10)

Denali is six million acres of wild land, bisected by one ribbon of road. Travelers along it see the relatively low-elevation taiga forest give way to high alpine tundra and snowy mountains, culminating in North America's tallest peak, 20,310 ft (6,190.5 m) Denali. Wild animals large and small roam un-fenced lands, living as they have for ages.

Humans have resided in Denali for over 13,000 years—the earliest site of human habitation reaching back 13,000 years ago (Holmes 1986). These people were neolithic migrants who traversed the Bering Strait land bridge, moving through ice-free corridors as they established themselves up and down the Pacific coast and some interior regions of North America. Due to the vast and remote nature of Denali, human settlement has always been sparse, though human migration, temporary settlements, and encampments have been a standard trend of human population in the region.

More than a century ago, two remarkable men spent the winter in a cabin not far from the Toklat River. Their experience and interaction with the wild landscape changed them. In turn, they came to have a profound influence on preserving the landscape for generations to come.

Charles Sheldon, an early conservationist and gentleman hunter from Vermont, along with Harry Karstens, a legendary outdoorsman and dog musher, struck upon an idea over the

long winter to make of the place the world's first national park established to conserve wildlife. By 1917, after almost a decade of hard work, Sheldon and others persuaded Congress to create Mount McKinley National Park. Four years later, in 1921, Karstens was hired on as its first superintendent.

The Denali Borough resident population declined from 1,970 in 2013 to 1,919 in 2015. These residents are most representative of the Denali BR's population. The demographic in this borough are primarily white in the 25-40 year-olds cohort. Alaska Native population the borough is 4%, which is astonishing when compared with the other population unit of Yukon-Koyukuk, which is over 72% Alaska Native. The Yukon-Koyukuk Census Area is not a municipal unit, and extends a great deal beyond Denali BR. Its south eastern portion rests within the BR, which captures the villages of Nikoli, Lake Minchumina, and Telida. Together, these native subsistence communities total 200 Athabascan persons (Collins 2004), of the total 5,533 persons in the entire Yukon-Koyukuk Census Area. Noteworthy is the high summer seasonal human population of the BR, tourists and seasonal employees can be classified as acute, short-term amenity migrants. During any given summer evening, over 10,000 people are living in seasonal housing units, campgrounds and hotels within the Denali Borough. In all three census units, females comprise the majority of employed and higher educated (BA/BS and above) individuals, but also rank among the poorest and less likely to be owners of firms. This difference is quite high in the majority of the Mat-Su borough, but in Denali and Yukon-Koyukuk, this gap is smaller: 301 (male- non-minority owned), to 125 (female- non-minority owned), and 199 (male) to 132 (female), respectively. Overall, the population density of the BR itself lies between 0.1 and 0.005 people/km^2.

Major ecosystem type: There are four major ecosystems in the BR: taiga, tundra, riparian and alpine (see Figure 3.1 for Denali BR Landcover classes). Each interact on the landscape to form an even larger ecological system that ranges from boreal (taiga) forest in lower elevations, tundra and alpine-tundra, and alpine, as the BR topography climbs to "the High One" (Denali). The elevational gradient ranges from 68.5 meters to 6,190.5 meters.

Major habitats and land cover types: Boreal-Spruce/Open woodland Sprunce; Tundra sparse vegetation; Tundra peatland; Snow-Ice.

Bioclimatic zone : Sub-arctic

Location (latitude and longitude): 63.1148°N, 151.1926°W

Total Area (ha): (7) 18,032,453.64

Core area(s): (7) 876,796.07

Buffer zone(s): (7) 991,444.47

Transition area(s): 15,549,341

Altitudinal range (metres above sea level): (11.2) 68.5 meters to 6,190.5 meters

Zonation map(s):
Figure 2.2.2. A map of Denali Biosphere Region Zone Overview, highlights the boundaries of the core, transition zones, and managed use areas.

Figure 2.2.3. A map of Denali Biosphere Region Zones and Features, highlights zones, including unique features to the Denali BR, including the Cantwell Traditional Use Area.

Figure 2.3.8. A map of Denali Biosphere Region Athabascan Languages, highlights the Athabascan languages of the Denali BR

Figure 3.1. A map of Denali Biosphere Region Land Cover, highlights the 25 different landcover classes within the Denali BR.

Figure 7.2.2. A map of Denali Biosphere Region Areas of Partnership and Cooperation in Governance, highlights the different ownership of land parcels outside Denali National Park and Preserve proper.

Appendix B. Promotion and Communication Materials for the Biosphere Reserve

Provide some promotional material regarding the site, notably high quality photos, and/or short videos on the site so as to allow the Secretariat to prepare appropriate files for press events. To this end, a selection of photographs in high resolution (300 dpi), with photo credits and captions and video footage (rushes), without any comments or sub-titles, of professional quality – DV CAM or BETA only, will be needed.

In addition, return a signed copy of the following Agreements on Non-Exclusive Rights for photo(s) and video(s).

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

Organización
de las Naciones Unidas
para la Educación,
la Ciencia y la Cultura

Организация
Объединенных Наций по
вопросам образования,
науки и культуры

منظمة الأمم المتحدة
للتربية والعلم والثقافة

联合国教育、
科学及文化组织

UNESCO PHOTO LIBRARY

Bureau of Public Information

AGREEMENT GRANTING NON-EXCLUSIVE RIGHTS

For examples of photos and videos, please see the park's photo gallery and Heartbeats video. Additional promotional materials may be provided upon request.

Reference:

a) I the undersigned, copyright-holder of the above mentioned video(s) hereby grant to UNESCO free of charge the non-exclusive right to exploit, publish, reproduce, diffuse, communicate to the public in any form and on any support, including digital, all or part of the photograph(s) and to license these rights to third parties on the basis of the rights herein vested in UNESCO .

b) These rights are granted to UNESCO for the legal term of copyright throughout the world.

c) The name of the author/copyright holder will be cited alongside UNESCO's whenever his/her work is used in any form.

I certify that:

a) I am the sole copyright holder of the video(s) and am the owner of the rights granted by virtue of this agreement and other rights conferred to me by national legislation and pertinent international conventions on copyright and that I have full rights to enter into this agreement.

b) The video(s) is/are in no way whatever a violation or an infringement of any existing copyright or license, and contain(s) nothing obscene, libelous or defamatory.

Name and Address:

Dave Schirokauer: Chief of Resources. *Email: dave_schirokauer@nps.gov*
Dr. Rose Keller: Social Scientist. *Email: rose_keller@nps.gov*
Denali Biosphere Region
Denali National Park and Preserve
PO Box 9
Denali Park, AK 99755, USA



Signature: Dave Schirokauer Date: September 22, 2016

(Sign, return to UNESCO two copies of the Agreement and retain the original for yourself)
Mailing address: 7 Place Fontenoy, 75352 Paris 07 SP, Direct Telephone: 00331 – 45681687
Direct Fax: 00331 – 45685655;
e-mail: photobank@unesco.org; m.ravassard@unesco.org

ANNEX II. AGREEMENTS AND REPORTS

Appendix C. Agreements List

List of Agreements connected to the Denali Biosphere Region

With Whom	Agreement Type	Purpose
University of Alaska Fairbanks	Cooperative Agreement (CESU)	Paleontology
University of Alaska Anchorage	Cooperative Agreement (CESU)	Native place names
The Pennsylvania State University	Cooperative Agreement (CESU)	Soundscape investigations
Northern Arizona University	Cooperative Agreement (CESU)	Permafrost dynamics
Institute of Arctic Biology, University of Alaska Fairbanks	Cooperative Agreement (CESU)	Wildlife investigations
Colorado State University	Cooperative Agreement (CESU)	Soundscape investigations
University of Washington	Cooperative Agreement (CESU)	Mesocarnivore dynamics
DOI Bureau of Land Management	Memorandum of Understanding	Land management
USDA Forest Service	Memorandum of Understanding	Land management, forest resources inventory
USDA Natural Resource Conservation Service	Cooperative Agreement Memorandum of Understanding	Soil surveys
US Geological Survey	Memorandum of Understanding	Geologcial mapping
Biological Resources Division, US Geological Survey	Interagency Agreement	Caribou population dynamics
Western Regional Climate Center, Desert Research Institute	Cooperative Agreement	Data management
State of Alaska Dept. of Natural Resources	Memorandum of Understanding	Mined area reclamation
State of Alaska Fish and Game	Memorandum of Understanding	Wildlife data sharing, wildlife population dynamcis research
US Fish and Wildlife Service	Memorandum of Understanding	Nesting waterbird populations
Cantwell Native Village	Subsistence Resource Charter	Land management, recycling
Nikolai Native Village	Subsistence Resource Charter	Subsistence management
McGrath Native Village	Subsistence Resource Charter	Subsistence management
Telida Native Village	Subsistence Resource Charter	Native place names, subsistence management
Lake Minchumina Native Village	Subsistence Resource Charter	Subsistence management
Denali Borough	Memorandum of Understanding	Recycling
City of Talkeetna	Memorandum of Understanding	Historic preservation and interpretation
Tri-valley School	Memorandum of Understanding	School to work - building trades

Appendix D. Research Program List

List of Denali Biosphere Region Research Projects

Research Program	Start Date	End Date
Ecology of Brown Bears in Denali National Park and Preserve	Jan-70	Dec-05
Air Quality Monitoring (NPS study number 372)	Jan-90	Dec-06
Monitoring Occupancy of Nesting Areas, Reproductive Success, and Nesting Phenology of Golden Eagles and Gyrfalcons in Denali National Park, Alaska.	Jan-90	Dec-06
Monitoring Avian Productivity and Survivorship in Denali National Park and Preserve	Jan-92	Dec-02
Monitoring Avian Productivity and Survivorship in Denali National Park and Preserve	Jan-92	Dec-02
Snow Surveys (no.376)	Jan-92	Dec-02
Mass Movement Survey Mile Post 45, Denali Park Road Denali National Park and Preserve	May-92	May-01
Passerine monitoring in Denali National Park and Preserve, Alaska	May-92	Dec-02
National Breeding Bird Survey	Jun-92	Dec-02
Meteorological Monitoring (No. 370)	Jan-93	Dec-02
Breeding Biology and Dietary Analysis of Northern Hawk Owls in Interior Alaska Taiga Forests	Jan-00	Dec-02
Fine particulate matter monitoring in Denali National Park and Preserve	Apr-00	Jul-03
Parks as Classrooms Mountaineering Curriculum	Jan-01	Oct-02
UV-B Monitoring as Part of the PRIMENet Program [project has been ongoing since 1997]	Jan-01	Dec-04
Conservation genetics and population history of arctic plant species	Feb-01	Jan-04
Assessing the presence and potential impacts of polyaromatic hydrocarbons resulting from snowmobiles.	Apr-01	Dec-03
Development of a LTEM Program for Denali National Park and Preserve: Incorporating previously studied plots into the LTEM framework and understanding successional trajectories on glacial floodplains: Viereck Vegetation Plots on the McKinley and Thorofare River Floodplains	May-01	Dec-03
FEE DEMO Geology Exhibit for Eielson Visitor Center	May-01	Sep-03
Optimizing Pulsed Radar for Investigations of Snow Processes	May-01	Dec-01
The Relationship Between Acute Mountain Sickness and Rating of Perceived Exertion in Climbers on Mount McKinley	May-01	Jun-01
Upgrade to meteorological station on Mt. McKinley.	May-01	Dec-10
Evolution of heterostyly and homostyly in Dodecatheon and its closest relatives in Primula (Primulaceae): a comparative developmental study	Jun-01	Sep-03
Glacial Invertebrate Survey	Jun-01	Dec-01
Insect diversity and vegetation in Long-Term Ecological Monitoring plots	Jun-01	Dec-01
Late Paleozoic Paleobotany and Tectonostratigraphic context of the Mt. Dall Conglomerate, Denali National Park and Preserve, AK.	Jun-01	Dec-04
Protein and Tannins in Summer Browse May Limit Productivity Of Moose in Interior Alaska	Jun-01	Dec-01
Vascular plant inventory of Denali National Park and Preserve	Jun-01	Dec-04
Size- and time-resolved aerosol chemistry at Denali National Park and Preserve	Jul-01	Dec-02
Assessing Adequate Snowcover and Snow Conditions for Snowmobiling (no. 628)	Jan-02	Dec-07
Managing Human Use And Wildlife Resources South Side Denali National Park And Preserve: Avian Component	Jan-02	Dec-02
Monitoring Freeze/Thaw Transition in Boreal Forests with Spaceborne Microwave Sensors	Jan-02	Dec-17
Factors controlling establishment and growth of Taraxacum officinale in Alaskan National Parks	Mar-02	Dec-09
NPS Wildland Fire Activity Monitoring	Mar-02	Dec-04
A Proactive Approach to Protecting a Threatened Ecoregion; Baseline Studies in the Toklat Basin, Denali National Park: biological studies component	Apr-02	Jun-06

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Pathophysiology of Acute Mountain Sickness: Role of Serum Vascular Endothelial Growth Factor	May-02	Jun-02
Survey of Climber's Knowledge of Causes, Prevention, and Treatment of Acute Mountain Sickness, and Frostbite on Mt. McKinley (Denali)	May-02	May-02
Long-term monitoring of vegetation resources in Denali National Park and Preserve	Jun-02	Dec-08
Palynology and Paleoecology of the Lower Cantwell Formation, Denali National Park, Alaska	Jul-02	Sep-02
Small mammal inventory of Alaska's national parks and preserves	Jul-02	Aug-02
Biogeochemical and biochemical pathway investigations of cadmium (Cd) in subarctic ecosystems using a bioaccumulator species (willow)	Aug-02	Dec-03
Bathymetry and water quality of McLeod, Foraker and Herron Lakes	Sep-02	Sep-02
Using Semi-Permeable Membrane Devices to Evaluate Temporal and Spatial Distribution of Persistent Organic Pollutants in Alaska	Sep-02	Dec-04
Dynamics of the Denali Caribou Herd	Oct-02	Dec-03
Assessing the burn severity of wildland fire in Denali National Park and Preserve using Landsat imagery, the Normalized Burn Ratio and the Composite Burn Index	Jan-03	Dec-06
Park Oral History	Jan-03	Jan-15
Western Airborne Contaminants Assessment Project	Mar-03	Dec-06
North American Migration Count	Apr-03	Dec-08
Dynamics of wolf family lineages and wolf-prey systems in the Denali region, Alaska	May-03	Apr-04
Evaluation of structural mechanisms of uplift of Mt. McKinley, Alaska	May-03	Sep-05
Timing and Extent of Glaciation on the northern slopes of Alaskan Range.	May-03	Jun-06
A Proactive Approach to Protecting a Threatened Ecoregion; Baseline Studies in the Toklat Basin, Denali National Park: Surficial Geology Component	Jun-03	Dec-06
Early Tertiary Slab Window in Alaska	Jun-03	Sep-05
Geologic mapping exercises in Central Denali Park [Long-Term, Bi-annual, 10-14 day]	Jun-03	Dec-11
Glacier Ecology: 2003 Field Season Inventory and Monitoring of Pacific Northwest Glaciers Macro- and Micro-Communities.	Jun-03	Dec-10
Inventory of Freshwater Fishes within the Central Alaska Network	Jun-03	Aug-03
Patterns of serial fault rupture along the Denali fault, Alaska	Jun-03	Sep-07
Timing and Kinematics of Deformation of the Kahiltna Assemblage: Evidence for Accretion of the Talkeetna Superterrane	Jun-03	Dec-05
Polyploidy, biogeography and evolution of breeding systems in Primula sect. Aleuritia with special emphasis on a allotetraploid complex: an integrated phylogenetic, population genetic, and molecular cytogenetic approach	Jul-03	Dec-05
The Effects of Landscape Structure on the Distribution of Wood Frogs in Denali National Park	Jul-03	Dec-04
Alaska Regional Haze Monitoring Pilot Study	Aug-03	Dec-06
Long term ecological monitoring of streams	Aug-03	Dec-11
Winter road users and their perceptions of the Aufeis Removal Project	Jan-04	Dec-04
Visitor use survey in high use climbing areas and landing areas	Apr-04	Oct-05
Carbon Monoxide Poisoning and Acute Mountain Sickness: Investigating a Possible Correlation in High Altitude Mountaineering	May-04	Jun-05
Identification and Classification of Snow Pool Mosquitoes and mosquitoes in the genera Aedes, Ochlerotatus and Culex in the United States and Russia	May-04	Dec-05
The Frequency of Wolves in a Sample Area of the Teklanika River Corridor (Part I) and Controlled Human Behavior to Minimize Wolf Incidents in the Igloo Campground: A Baseline Monitoring Program (Part II)	May-04	Sep-04
Alaska Western Area Fire Management Fire Monitoring Program Denali National Park and Preserve	Jun-04	Dec-13
Aquatic Resources of Proposed North Access Corridor	Jun-04	Dec-06

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Spiders of Denali National Park	Jun-04	Jul-04
Teklanika Archeological District Site Stabilization	Jun-04	Sep-06
Assessment of vegetation damage caused by an ORV incursion into Denali NP/P	Jul-04	Dec-06
Watershed delineation	Jul-04	Jul-04
Cryptogams of Denali NP&P	Aug-04	Sep-05
Net effects of treeline advance on carbon pools in Denali National Park	Sep-04	Sep-05
Wolf Population Monitoring in Denali National Park and Preserve	Jan-05	Sep-19
Assessing ORV impacts in Denali National Park and Preserve	May-05	Oct-20
Exotic Plant Mapping and Inventory	Jun-05	Dec-05
Mineralogy of Denali National Park River Sediment	Jun-05	Sep-05
Patterns of and above- and below-ground controls on recent white spruce establishment in tundra in Denali National Park, Alaska	Jun-05	Jan-07
Repeated Global Positioning System (GPS) and Absolute Gravity Measurements to Measure Active Crustal Deformation in Southern Alaska	Jun-05	Sep-13
Structural constraint on the late Cretaceous to early Eocene development of the Alaska Range suture zone	Jun-05	Dec-06
Using multigene phylogenies to reconstruct the origin and losses of the lichen symbiosis.	Jun-05	Jun-05
Demonstration of Randomized-Design for Assessment of Wadeable Streams in Alaska	Jul-05	Dec-06
A study on the impact of climate change, in relation to General Circulation Models and published literature from surrounding sites at Wonder Lake, Denali National Park.	Aug-05	Aug-05
Collaborative study on permafrost characteristics of Wrangell-St Elias and Denali parklands (addendum to Effects of aggradation and degradation of ground ice in the evolution of permafrost-dominated landscapes under a changing climate)	Aug-05	Dec-08
Earthquake Behavior of the Denali Fault, Central Alaska Range	Aug-05	Dec-11
Paleontological survey of the lower Cantwell Formation (Cretaceous), Denali National Park and Preserve	Aug-05	Dec-09
Denali Seismic Monitoring Sites	Oct-05	Dec-05
Soundscape Study of Denali National Park and Preserve	Jan-06	Dec-10
Analyzing the Effects of Traffic on the Behavior and Viewability of Grizzly Bears and Dall Sheep	Mar-06	Sep-09
A Predictive Study of Use Impacts on the Denali Park Road: A study plan to support analysis and management of carrying capacity	Apr-06	Dec-10
Limnology and water quality of Wonder Lake and other selected lakes, Denali National Park and Preserve, Alaska	Apr-06	Dec-08
Studying Traffic Flow Patterns in Denali National Park with GPS Telemetry	Apr-06	Dec-14
Central Alaska Network Shallow Lake Monitoring Project	May-06	Dec-08
Glacier Monitoring in Denali National Park and Preserve	May-06	Dec-20
Neurological deficits during ascent of Denali	May-06	Jun-06
Avian Influenza Sampling in Arctic Warblers (*Phylloscopus borealis kennecotti*) in Denali National Park and Preserve	Jun-06	Aug-06
Expanded earthquake monitoring near Kantishna with portable seismometers	Jun-06	Sep-07
Long-term monitoring of restoration of placer-mined watersheds in Denali National Park and Preserve	Jun-06	Dec-09
A Study of arctic plant evolution and phylogeography in the Alternifolium Group of the genus Chrysosplenium (Saxifragaceae)	Jul-06	Aug-06
Plate Boundary Observatory (PBO) stations in Denali National Park monitors tectonic and magmatic process using high precision Global Positioning Systems (GPS).	Jul-06	Sep-17
Collect exhibit specimens for Eielson Visitor Center exhibits	Aug-06	Dec-11

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Detecting a deadly amphibian disease: are park visitors inadvertent vectors?	Aug-06	Feb-07
Monitoring of Small Mammal Populations in Denali National Park and Preserve	Aug-06	Aug-14
Lake ice and snow studies at Horseshoe Lake, Denali National Park and Preserve: Scientific research contributing to science education	Oct-06	Sep-11
Altitude Aptitude	Jan-07	Aug-07
Interpreting the Alaska National Park Experience	Mar-07	Jan-10
Trajectory and fate of human waste on the Kahiltna Glacier	Apr-07	Dec-08
Population Biology of the Wood Frog in a Rapidly Changing Environment: Site 1 - Denali National Park	May-07	Dec-09
2007 Alaska and Yukon Self-Drive Tourism Study	Jun-07	Dec-07
Artists' Sense of Place: The Connection of Art and Environment	Jun-07	Dec-09
Chemical Fate and Transport of Antimony in Aqueous Geochemical Systems of Interior Alaska and the Yukon	Jun-07	Dec-07
Denali Road Study Physical Indicators Monitoring	Jun-07	Dec-15
Does a normobaric hypoxia sleep regimen affect work performance at high altitude?	Jun-07	Jul-07
Ecological relationships of Bigfoot in Denali National Park and Preserve	Jun-07	Jun-17
Integrated Paleoenvironmental Reconstruction of the Lower Cantwell Formation near Sable Mountain, Denali National Park, Alaska	Jun-07	Dec-09
Long term trends and spatial variability in arctic haze at four sites in western Alaska.	Jun-07	Dec-12
Patho-physiological changes induced by hypoxia	Jun-07	Jun-07
Effects of Climate Change, Glacial Retreat, & Snowfield Loss on Habitat Condition & the Affect on Wild Sheep Populations & Distribution in Polar & High Mountain Ecosystems in Alaska, Russia, & Asia	Jul-07	Aug-07
The floral ecosystem in the lower Cantwell Formation of Denali National Park and Preserve: Evolutionary, paleoecological, and paleoclimatic implications.	Jul-07	Dec-07
Using Beaver Colonies as a Model for Ecosystem Land Use and Recovery in Denali National Park and Preserve, Alaska	Jul-07	Mar-08
A shrubby future for Denali? Investigation on the effect of recent warming on alpine shrubs in Denali National Park and Preserve	Aug-07	Dec-08
Developing Monitoring Protocols for Assessing the Extent and Condition of Informal Trails within Denali National Park	Aug-07	Nov-09
Development and implementation of a long term ecological monitoring program for the streams and rivers of Denali National Park and Preserve	Aug-07	Mar-08
Distribution patterns of polynuclear aromatic hydrocarbons (PAHs) and trace elements in mosses, Hylocomium splendens and Pleurozium schreberi, collected from different forest communities in Alaska and Eastern Europe.	Aug-07	Sep-07
Inventory of the mosses, liverworts, and lichens of Denali National Park and Preserve, Alaska	Aug-07	Dec-12
Terrestrial cosmogenic dating of the Wonder Lake moraines, McKinley River Basin: in pursuit of understanding the nature of glaciation and climate change in the Denali National Park	Sep-07	Sep-07
The research experience of researchers working in Denali 2004-2008: a survey	Sep-07	Sep-09
A study of aquatic invertebrates in creeks and rivers in Denali National Park and Preserve [tributaries to the Nenana River]	Oct-07	Dec-07
Comprehensive Archeology Survey	Oct-07	Dec-09
When Tectonics Give Rise, Streams Respond: Using Longitudinal Stream Profiles to Determine Areas of Tectonic Activity	Jan-08	Apr-08
Spatial patterns of tree establishment at the alpine treeline ecotone	Mar-08	Dec-09
Understanding lake disappearance through time in northern Alaskan parks	Mar-08	Mar-12
Airborne surveying of glacier surface elevation change	May-08	Dec-11

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Developing a multiyear Trend Model for Habitat use of Wood Frogs (*Rana sylvatica*) in Denali National Park, Alaska; A study using occupancy modeling.	May-08	Jul-08
Drillsite Reconnaissance and Snow Chemistry Survey in Denali National Park	May-08	Jun-13
Evaluation of Palliative Performance for Rural Alaska Dust Control	May-08	Aug-09
Monitoring Indicators of Visitors' Backcountry Experience in Denali National Park	May-08	Sep-08
A park visitors view of the growth of a continent	Jun-08	Sep-08
Climate Change Communication in the face of Public Uncertainty	Jun-08	May-09
Documenting presence and distribution of bird species of conservation concern in selected areas of Denali National Park and Preserve, Alaska	Jun-08	Dec-18
Effects of survey timing on the measurement of current social and resource conditions	Jun-08	Jul-08
Flower Color Evolution in the Arctic: Integrating Genomic Research and Undergraduate Education in Polar Environments	Jun-08	Dec-08
Implementation of a long term ecological monitoring program for the streams and rivers of Denali National Park and Preserve	Jun-08	Dec-08
Using the ICESAT-GLAS lidar to estimate the amount, spatial distribution, and statistical uncertainty of aboveground carbon stocks of the North American boreal forest	Jun-08	Jun-11
Water quality from streams draining abandoned and reclaimed mined lands in the Kantishna Hills area, Denali National Park and Preserve, Alaska	Jun-08	Dec-10
A detailed study of an ancient high latitude terrestrial ecosystem and its implications for understanding climate change: the dinosaurs and their ecosystems within the Lower Cantwell Formation in Denali National Park	Jul-08	Dec-11
Denali National Park Aerial Sheep Survey	Jul-08	Dec-12
Evolution of glacier ice worms (Mesenchytraeus solifugus)	Jul-08	Dec-08
The consequences of permafrost degradation and plant water use strategies for plant community composition.	Jul-08	Dec-08
Northern Range Distribution of the Perennial Bunchgrass, Bromus carinatus	Aug-08	Sep-14
Moose Monitoring in Denali National Park and Preserve	Nov-08	Dec-20
Ecology of Moose in Denali National Park and Preserve	Jan-09	Dec-14
Climber's Perceptions on Denali: Crowding Concerns, Hazards, and Climber Demographics	May-09	Dec-09
Grizzly Bear Population Ecology and Monitoring Study	May-09	Nov-14
Understanding Movement Dynamics of the Southeast Fork Glacier: Tracking Visitor Waste	May-09	Jul-09
Assessing migratory movements of short-eared owls nesting in Alaska	Jun-09	Dec-10
Distribution and Prevalence of the Amphibian Chytrid Fungus (Batrachochytrium dendrobatidis) in the Northern Range of the Wood Frog (Rana [Lithobates] sylvatica).	Jun-09	Dec-14
Microbial Succession in Soils at Retreating Glaciers	Jun-09	Dec-09
Hydroecology of upwelling zones in glacierized catchments (Note: Stony Creek does not have a glacial source)	Jul-09	Jul-09
Timing, distribution, and character of tephra fall from the 2009 eruption of Redoubt Volcano, Alaska	Jul-09	Jul-09
Understanding Site Formation and Cultural Activities at Teklanika West (HEA-001)	Jul-09	May-10
Ice on the Edge: Global Warming and a New Archeological/Paleontological Research Frontier in Denali National Park.	Aug-09	Dec-09
Stable Isotope hydrology and climate of Denali National Park: modern context for paleoclimate studies in central Alaska	Aug-09	Dec-10
Unraveling the divergence riddle: Linking local tree growth pattern with mechanistic tree growth models	Aug-09	Dec-10
Conduct a surface temperature inventory along elevation gradients in Denali National Park	Apr-10	Dec-13

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Impacts of Historic and Future Human Waste Disposal on Kahiltna Glacier, Mt. McKinley	Apr-10	Sep-10
Monitoring passerine bird populations in Denali National Park and Preserve, Alaska by the Central Alaska Network Monitoring Program. (Revised 2010)	Apr-10	Dec-03
The Effects of Changing Climate on Denali Park Glaciers: a Case Study on the Kahiltna Glacier	Apr-10	Sep-11
Assessing the Impacts of Climate Change on Boreal Forest Wetland Nesting Birds	May-10	Dec-12
Late Cretaceous Paleoclimate and Ecological Change Preserved in the Cantwell Formation, Central Alaska Range	Jun-10	Sep-11
Geomorphic Evaluation of the Toklat River, AK near mile 53 of the Park Road, Denali National Park	Jul-10	Oct-11
Prehistoric Upland Use in Denali National Park: A Proposal to Conduct Archaeological Field Research Along the Savage River	Jul-10	Aug-10
Systematic Investigations of the Federally Threatened Eutrema penlandii Emphasizing the Conservation of Genetic and Species Diversity	Jul-10	Jul-10
The bones of Denali: Historical ecological insight and the identification of past caribou calving grounds	Jul-10	Dec-06
Collect baseline inventory of night sky quality	Sep-10	Dec-12
Monitoring dust palliative applications to the Denali Park Road	Jan-11	Dec-15
Estimating Recreation Visits in Denali National Park and Preserve	Mar-11	Jun-12
A field assessment of Focus Glaciers for the "Alaska NPS Glacier Inventory and Change Assessment" project	Apr-11	Dec-13
Developing a more efficient and reliable immobilization protocol for grizzly bear managers and researchers	May-11	Apr-12
Gasline Lidar ground control	May-11	Oct-11
Social normative study of backcountry visitorss acoustic expectations and experiences in Denali Park and Preserve	May-11	Sep-12
Geochronology of the Colorado Creek basin, Denali National Park, Alaska: improved constraints on Oligocene environments, climate, and tectonics	Jun-11	Jun-13
Geologic hazards study of Denali National Park	Jun-11	Jun-11
Paleontological Resources Inventory of Denali National Park and Preserve	Jun-11	Oct-20
Reconstructing and Mapping the Historic Geoscience Exploration of Stephen R. Capps in Denali National Park and Preserve, Alaska	Jun-11	Aug-11
Rock-colonizing algae	Jun-11	Dec-15
Understanding Change: How Communities Perceive Climate Change at a Local Level	Jun-11	Oct-13
Development of an integrated catchment model for the Toklat River: a quantification of the impact of glacial retreat upon water resources and nutrient dynamics in Denali National Park	Jul-11	Aug-12
Glacial Terminus Surveys and Photo Documentation in the Kichatna Mountains, Denali National Park and Preserve, Alaska.	Jul-11	Dec-12
Lake Minchumina Cultural Resources Inventory Project (continuation of NPS study number 839)	Jul-11	Dec-13
Paleoenvironmental Reconstruction of the Late Cretaceous Cantwell Formation near Fang Mountain and Polychrome Mountain, Denali National Park, Alaska	Jul-11	Aug-11
Population Genetics of Denali National Park Blackfish (Esociformes, Esocidae: Dallia).	Jul-11	Jul-11
Rising temperatures and the influence of nonlinear thresholds on forest expansion in Denali National Park and Preserve, Alaska	Jul-11	Aug-11
Visitor Services Project- Visitor Study	Jul-11	Jul-12
The critical role of biological weathering in shaping high altitude landscapes	Aug-11	Aug-13
A noninvasive study to estimate wolverine (*Gulo gulo*) populations in Denali National Park and Preserve.	Jan-12	May-12
Spatial distribution of *corticolous myxomycetes* (related to permit 69136: Genes or environment? White spruce and the divergence effect at Alaska's tree lines.)	Jan-12	Sep-14

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Development of Passive Samplers for Measuring Atmospheric Ionic Pollutants in Alaska National Parks - Denali NP Component	Mar-12	Dec-12
Acetazolamide for the prevention of high altitude illness: a comparison of dosing	Apr-12	Aug-14
Developing Geophysical Constraints on Alaska Range Glacier Ice Volume Estimates	Apr-12	Jul-14
Collecting dragonfly larvae for mercury analysis as part of a nationwide NPS citizen science program	May-12	Dec-16
Melatonin as a Countermeasure to the Mal-Effects of High Altitude on Sleep and Cognitive Function on North America's Highest Peak	May-12	Jun-12
A survey of bees (Superfamily Apoidea: Apiformes) and flower flies (Family Syrphidae) in Denali NPP and a multiregional evaluation of pollinator response to climate change in critical habitats service-wide	Jun-12	Sep-13
An Investigation of Hiker Encounter Rates on the Triple Lakes Trail	Jun-12	Dec-12
Continued monitoring of vegetation succession on terraces of the McKinley River	Jun-12	Dec-12
Documenting Natural and Cultural Resource Change Using Repeat Photography in Denali National Park and Preserve, Alaska	Jun-12	Jun-02
Genes or environment? White spruce and the divergence effect at Alaska's tree lines.	Jun-12	Dec-14
Green Parks: An Evolving Vision for the National Park Service	Jun-12	Jun-12
Mesocarnivore Community Response to Wolf Presence, Prey Availability, and Snowpack	Jun-12	Aug-19
Sand-dune formation and human landuse of Beaverlog Lakes, Denali National Park and Preserve, Central Alaska	Jun-12	Jul-12
Vermicomposting human waste in outside environment at latitude 62 degrees North, Talkeetna, Alaska	Jun-12	Dec-14
Exploring the Bases of Visitor Standards in National Parks	Jul-12	Jul-12
Nitrogen Dynamics and Red Senescence in Three Northern Plants	Jul-12	Jul-14
Paleoseismic and Structural Characterization of the Hines Creek/Park Road fault(?) at Denali National Park, Alaska	Jul-12	Jun-13
Parnassius phoebus (Lepidoptera, Papilionidae) live close-up photographs	Jul-12	Jul-12
Giardia and Cryptosporidium in surface and treated water of Denali National Park	Aug-12	Sep-15
Natural Collection in Support of Rika Mouw's Artist-in-Residence Art Piece	Aug-12	Aug-12
Geophysical Mapping of the Park Road Fault Denali National Park, Alaska	Oct-12	Dec-12
Central Alaskan Climate and Glacier Response over the Past 1,000 Years	Jan-13	Jun-09
The effects of a century of climate change on Denali's small mammal fauna	Apr-13	Jun-15
Prioritizing conservation actions for North American grizzly bears (*Ursus arctos*) by testing their efficacy as a flagship species	May-13	Dec-13
A late Cenozoic record of restraining bend initiation and evolution along the Denali fault at Mount McKinley, Alaska	Jun-13	Dec-15
Altitude Induced Hypoxia Effects on Cognitive and Emotional Processing	Jun-13	Jul-13
Post-Exercise Oxygen Saturation and Hydration Status as Predictors of Summit Success on Denali	Jun-13	Jul-13
The hydrology of biological hotspots in a glacierized catchment: an integrated tracing and modeling study.	Jun-13	Dec-15
The role of local and broad scale habitat structure in determining distribution and abundance of arctic ground squirrels	Jun-13	Jul-13
Exploring attitudes and values in visitor discourses of wolves at Denali National Park and Preserve	Jul-13	Jul-13
Holocene erosion rate of the Alaska Range	Jul-13	Jul-15
Geochronological framework for the Cantwell Formation: Denali National Park	Aug-13	Oct-16
Monitor thermokarst index sites in the Toklat Basin of Denali National Park and Preserve	Aug-13	Dec-03

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Specialized adaptations and restricted niche preferences of cold-adapted saxifrages (Micranthes, Saxifragaceae) provide new insight into the effects of climate change on the Arctic flora	Aug-13	May-18
Surveying and Visualization of Near-Surface Structures by using Ground Penetrating Radar (GPR) and Structure from Motion (SfM)	Jan-14	Dec-18
High Elevation Climate Monitoring on Mount McKinley	Mar-14	Dec-18
Measuring the Biotic Integrity of Eldorado Creek, Denali National Park and Preserve with Stream Restoration	Apr-14	Dec-14
Advancing Mosses and Retreating Glaciers: A Phylogenetic Approach to Ecosystem Succession	May-14	Sep-14
Assessing Sediment Transfer using Remote Sensing and Ground-Truthing on the Toklat River, Denali National Park and Preserve, AK	May-14	May-16
Spring Abundance Surveys for Willow and Rock Ptarmigan	May-14	May-18
Archaeological Survey of the Stony Creek and Toklat River Corridor	Jul-14	Dec-14
Archaeological Survey of the Upper Teklanika River Valley, Denali National Park and Preserve	Jul-14	Dec-14
Denali Arthropod Bioblitz	Jul-14	Jun-15
Monitor physical and biological components of permafrost on burned and un-burned sites near Gosling Lake, Denali National Park and Preserve	Aug-14	Jan-15
Investigation of ecology of insect associated symbiotic microorganisms.	Nov-14	Nov-19
Importance of the reference condition when measuring the biotic integrity of streams with restoration	Mar-15	Sep-17
Using GPS-accelerometer collars to explore landscape-scale movement costs in free-ranging wolves	Mar-15	Nov-15
Snowshoe hare and white spruce interactions in a rapidly changing landscape	Apr-15	Dec-15
Examining the Potential for Citizen Science and Volunteered Geographic Information in Denali National Park and Preserve.	May-15	Aug-16
A Survey of Alaskan Mosquito Biodiversity	Jun-15	Dec-15
Climatic influences on treeline expansion in *Picea glauca*: A genetic approach	Jun-15	Sep-16
Denali Summit Elevation Survey	Jun-15	Sep-15
Selection and Procurement of Nenana Valley Basalts: A Proposal to Sample Basalts in Denali National Park	Jun-15	Sep-16
The Critical Connections Program: studying the full life-cycle of Denali's migratory birds	Jun-15	Dec-20
Upscaling hydroecological understanding in glacierized catchments within Denali National Park	Jun-15	Dec-15
Adaptive population genomics of the native pollinator *Bombus bifarus* (Hymenoptera: Apidae) across its latitudinal range	Jul-15	Jul-15
Culture Camps and evaluating the late Pleistocene and early Holocene occupations at Teklanika West (HEA-001)	Jul-15	Jul-16
Dinosaurs of the lower Cantwell Formation, Denali National Park and Preserve: insights into a Late Cretaceous, high-latitude ecosystem in a greenhouse world	Jul-15	Jun-02
Erosion and Moraine Deposition of the Muldrow Glacier across Changing Glacial Dynamics and Climates	Jul-15	Jun-16
Performance or fitness: do trees performing best sire most of the offspring?	Jul-15	Aug-16
Talkeetna Historic Archaeology Culture Camp	Jul-15	Jul-16
Using strontium isotopes in otoliths to determine natal origins, freshwater habitat use, and life history patterns of Chinook salmon in the Yukon River	Jul-15	Dec-18
Geochemical Characterization of Rhyolite Sources and Artifacts from National Park Service Lands, Alaska	Aug-15	Dec-16
Alaska Collaborative Visitor Transportation Study	Sep-15	Dec-17
Denali Seismic Monitoring Sites	Jan-16	Dec-20
Denali Seismic Monitoring Sites	Jan-16	Dec-20

List of Denali Biosphere Region Research Projects, *continued*

Research Program	Start Date	End Date
Mapping social values, visitor use activities, and conservation behaviors in Denali National Park and Preserve	Jan-16	Aug-17
Protect Wolf Packs by Determine Effects of Hunting on the Social & Age Structure in YELL & DENA	Mar-16	Jan-18
Tourist-Volunteers and Citizen Science: Case Study in Denali National Park and Preserve	Mar-16	May-17
Acoustic Monitoring in Denali, Summer Sites: 2016 – 2021	Apr-16	Nov-11
Evaluate displacement of birds by recreational activities in Denali National Park	Apr-16	Dec-10
Birch Creek Cemetery Documentation and Culture Camp	May-16	Sep-17
Denali Windy Corner Survey Monument	May-16	Aug-16
Don't Feed The Landfills	May-16	May-16
Geochronological framework for the Cantwell Formation: Denali National Park	May-16	Dec-17
Native Place Names Archeological Survey	May-16	Sep-19
Characterizing the unique cultural resources of Shellabarger Pass - Archaeology and Oral Interviews	Jun-16	Sep-19
Integrating two white spruce research plots into the long-term vegetation monitoring plot network for Denali NP&P.	Jun-16	Dec-40
Inventory Climate Sensitive Arthropod Biodiversity at Denali NP&P with Citizen Scientists	Jun-16	Jun-21
Survey of Media's Influence on Backcountry Hiker's Route Choice in Denali National Park	Jun-16	Oct-16
Dwarf rosebays hitched a ride across the Bering Strait: the evolutionary history of the high latitude plant genus *Therorhodion* (Ericaceae)	Jul-16	Jul-16
Increasing fire severity and the loss of legacy carbon from tundra ecosystems	Jul-16	Oct-18
Rates and drivers of land cover change in Denali	Jul-16	Dec-18
Visitor Use and Experience in Denali's Backcountry Pre-test	Jul-16	Dec-16
When the Freezer Breaks: Will Climate Warming Impact the Persistence of Resident Birds in Alaska?	Jul-16	Sep-20

Appendix E. Fauna and Flora Species List

Denali Biosphere Region Species List - Fauna

Category	Order	Family	Scientific Name	Common Names
Mammal	Artiodactyla	Bovidae	*Ovis dalli*	Dall's sheep
Mammal	Artiodactyla	Cervidae	*Alces alces*	Moose
Mammal	Artiodactyla	Cervidae	*Rangifer tarandus*	Caribou
Mammal	Carnivora	Canidae	*Canis latrans*	Coyote
Mammal	Carnivora	Canidae	*Canis lupus*	Gray wolf, Wolf
Mammal	Carnivora	Canidae	*Vulpes vulpes*	Red fox
Mammal	Carnivora	Felidae	*Lynx canadensis*	Lynx
Mammal	Carnivora	Mustelidae	*Gulo gulo*	Wolverine
Mammal	Carnivora	Mustelidae	*Lontra canadensis*	River otter
Mammal	Carnivora	Mustelidae	*Martes americana*	American Marten
Mammal	Carnivora	Mustelidae	*Mustela erminea*	Ermine, Short-tailed weasel
Mammal	Carnivora	Mustelidae	*Mustela nivalis*	Least weasel
Mammal	Carnivora	Mustelidae	*Mustela vison*	Mink
Mammal	Carnivora	Ursidae	*Ursus americanus*	American black bear, Black bear
Mammal	Carnivora	Ursidae	*Ursus arctos*	Brown bear, Grizzly bear
Mammal	Lagomorpha	Leporidae	*Lepus americanus*	Snowshoe hare
Mammal	Lagomorpha	Ochotonidae	*Ochotona collaris*	Collared pika
Mammal	Rodentia	Castoridae	*Castor canadensis*	American beaver
Mammal	Rodentia	Cricetidae	*Clethrionomys rutilus*	Northern red-backed vole, Red-backed vole
Mammal	Rodentia	Cricetidae	*Lemmus trimucronatus*	Brown lemming
Mammal	Rodentia	Cricetidae	*Microtus miurus*	Singing vole
Mammal	Rodentia	Cricetidae	*Microtus oeconomus*	Tundra vole
Mammal	Rodentia	Cricetidae	*Microtus pennsylvanicus*	Meadow vole
Mammal	Rodentia	Cricetidae	*Microtus xanthognathus*	Taiga vole, Yellow-cheeked vole
Mammal	Rodentia	Cricetidae	*Ondatra zibethicus*	Muskrat
Mammal	Rodentia	Cricetidae	*Synaptomys borealis*	Northern bog lemming
Mammal	Rodentia	Dipodidae	*Zapus hudsonius*	Meadow jumping mouse
Mammal	Rodentia	Erethizontidae	*Erethizon dorsatum*	Porcupine
Mammal	Rodentia	Sciuridae	*Glaucomys sabrinus*	Northern flying squirrel
Mammal	Rodentia	Sciuridae	*Marmota caligata*	Hoary marmot
Mammal	Rodentia	Sciuridae	*Spermophilus parryii*	Arctic ground squirrel
Mammal	Rodentia	Sciuridae	*Tamiasciurus hudsonicus*	Red squirrel
Mammal	Soricomorpha	Soricidae	*Sorex cinereus*	Cinereus shrew, Common shrew, Masked shrew
Mammal	Soricomorpha	Soricidae	*Sorex hoyi*	Pygmy shrew
Mammal	Soricomorpha	Soricidae	*Sorex monticolus*	Dusky shrew, Montane shrew
Mammal	Soricomorpha	Soricidae	*Sorex palustris*	Water shrew
Mammal	Soricomorpha	Soricidae	*Sorex tundrensis*	Tundra shrew
Mammal	Soricomorpha	Soricidae	*Sorex yukonicus*	Tiny shrew
Bird	Accipitriformes	Accipitridae	*Accipiter gentilis*	Northern goshawk
Bird	Accipitriformes	Accipitridae	*Accipiter striatus*	Sharp-shinned hawk
Bird	Accipitriformes	Accipitridae	*Aquila chrysaetos*	Golden eagle

Denali Biosphere Region Species List - Fauna, *continued*

Category	Order	Family	Scientific Name	Common Names
Bird	Accipitriformes	Accipitridae	*Buteo jamaicensis*	Red-tailed hawk
Bird	Accipitriformes	Accipitridae	*Buteo lagopus*	Rough-legged hawk
Bird	Accipitriformes	Accipitridae	*Buteo swainsoni*	Swainson's hawk
Bird	Accipitriformes	Accipitridae	*Circus cyaneus*	Northern harrier
Bird	Accipitriformes	Accipitridae	*Haliaeetus leucocephalus*	Bald eagle
Bird	Accipitriformes	Pandionidae	*Pandion haliaetus*	Osprey
Bird	Anseriformes	Anatidae	*Anas acuta*	Northern pintail
Bird	Anseriformes	Anatidae	*Anas americana*	American wigeon
Bird	Anseriformes	Anatidae	*Anas clypeata*	Northern shoveler
Bird	Anseriformes	Anatidae	*Anas crecca*	Green-winged teal
Bird	Anseriformes	Anatidae	*Anas discors*	Blue-winged teal
Bird	Anseriformes	Anatidae	*Anas penelope*	Eurasian wigeon
Bird	Anseriformes	Anatidae	*Anas platyrhynchos*	Mallard
Bird	Anseriformes	Anatidae	*Anas strepera*	Gadwall
Bird	Anseriformes	Anatidae	*Anser albifrons*	Greater white-fronted goose
Bird	Anseriformes	Anatidae	*Aythya affinis*	Lesser scaup
Bird	Anseriformes	Anatidae	*Aythya americana*	Redhead
Bird	Anseriformes	Anatidae	*Aythya collaris*	Ring-necked duck
Bird	Anseriformes	Anatidae	*Aythya marila*	Greater scaup
Bird	Anseriformes	Anatidae	*Aythya valisineria*	Canvasback
Bird	Anseriformes	Anatidae	*Branta bernicla*	Brant
Bird	Anseriformes	Anatidae	*Branta canadensis*	Canada goose
Bird	Anseriformes	Anatidae	*Bucephala albeola*	Bufflehead
Bird	Anseriformes	Anatidae	*Bucephala clangula*	Common goldeneye
Bird	Anseriformes	Anatidae	*Bucephala islandica*	Barrow's goldeneye
Bird	Anseriformes	Anatidae	*Chen caerulescens*	Snow goose
Bird	Anseriformes	Anatidae	*Clangula hyemalis*	Oldsquaw
Bird	Anseriformes	Anatidae	*Cygnus buccinator*	Trumpeter swan
Bird	Anseriformes	Anatidae	*Cygnus columbianus*	Tundra swan
Bird	Anseriformes	Anatidae	*Histrionicus histrionicus*	Harlequin duck
Bird	Anseriformes	Anatidae	*Melanitta fusca*	White-winged scoter
Bird	Anseriformes	Anatidae	*Melanitta nigra*	Black scoter
Bird	Anseriformes	Anatidae	*Melanitta perspicillata*	Surf scoter
Bird	Anseriformes	Anatidae	*Mergus merganser*	Common merganser
Bird	Anseriformes	Anatidae	*Mergus serrator*	Red-breasted merganser
Bird	Apodiformes	Trochilidae	*Selasphorus rufus*	Rufous hummingbird
Bird	Charadriiformes	Alcidae	*Brachyramphus marmoratus*	Long-billed murrelet
Bird	Charadriiformes	Charadriidae	*Charadrius semipalmatus*	Semipalmated plover
Bird	Charadriiformes	Charadriidae	*Charadrius vociferus*	Killdeer
Bird	Charadriiformes	Charadriidae	*Pluvialis dominica*	American golden-plover
Bird	Charadriiformes	Charadriidae	*Pluvialis squatarola*	Black-bellied plover
Bird	Charadriiformes	Laridae	*Larus argentatus*	Herring gull
Bird	Charadriiformes	Laridae	*Larus canus*	Mew gull

Denali Biosphere Region Species List - Fauna, *continued*

Category	Order	Family	Scientific Name	Common Names
Bird	Charadriiformes	Laridae	*Larus glaucescens*	Glaucous-winged gull
Bird	Charadriiformes	Laridae	*Larus philadelphia*	Bonaparte's gull
Bird	Charadriiformes	Laridae	*Sterna paradisaea*	Arctic tern
Bird	Charadriiformes	Scolopacidae	*Actitis macularia*	Spotted sandpiper
Bird	Charadriiformes	Scolopacidae	*Aphriza virgata*	Surfbird
Bird	Charadriiformes	Scolopacidae	*Arenaria interpres*	Ruddy turnstone
Bird	Charadriiformes	Scolopacidae	*Arenaria melanocephala*	Black turnstone
Bird	Charadriiformes	Scolopacidae	*Bartramia longicauda*	Upland sandpiper
Bird	Charadriiformes	Scolopacidae	*Calidris alba*	Sanderling
Bird	Charadriiformes	Scolopacidae	*Calidris alpina*	Dunlin
Bird	Charadriiformes	Scolopacidae	*Calidris bairdii*	Baird's sandpiper
Bird	Charadriiformes	Scolopacidae	*Calidris mauri*	Western sandpiper
Bird	Charadriiformes	Scolopacidae	*Calidris melanotos*	Pectoral sandpiper
Bird	Charadriiformes	Scolopacidae	*Calidris minutilla*	Least sandpiper
Bird	Charadriiformes	Scolopacidae	*Calidris pusilla*	Semipalmated sandpiper
Bird	Charadriiformes	Scolopacidae	*Gallinago delicata*	Wilson's Snipe
Bird	Charadriiformes	Scolopacidae	*Limnodromus scolopaceus*	Long-billed dowitcher
Bird	Charadriiformes	Scolopacidae	*Limosa haemastica*	Hudsonian godwit
Bird	Charadriiformes	Scolopacidae	*Numenius phaeopus*	Whimbrel
Bird	Charadriiformes	Scolopacidae	*Phalaropus fulicarius*	Red phalarope
Bird	Charadriiformes	Scolopacidae	*Phalaropus lobatus*	Red-necked phalarope
Bird	Charadriiformes	Scolopacidae	*Tringa flavipes*	Lesser yellowlegs
Bird	Charadriiformes	Scolopacidae	*Tringa incana*	Wandering Tattler
Bird	Charadriiformes	Scolopacidae	*Tringa melanoleuca*	Greater yellowlegs
Bird	Charadriiformes	Scolopacidae	*Tringa solitaria*	Solitary sandpiper
Bird	Charadriiformes	Stercorariidae	*Stercorarius longicaudus*	Long-tailed jaeger
Bird	Charadriiformes	Stercorariidae	*Stercorarius pomarinus*	Pomarine jaeger
Bird	Coraciiformes	Alcedinidae	*Ceryle alcyon*	Belted kingfisher
Bird	Falconiformes	Falconidae	*Falco columbarius*	Merlin
Bird	Falconiformes	Falconidae	*Falco peregrinus*	Peregrin falcon
Bird	Falconiformes	Falconidae	*Falco rusticolus*	Gyrfalcon
Bird	Falconiformes	Falconidae	*Falco sparverius*	American kestrel
Bird	Galliformes	Phasianidae	*Bonasa umbellus*	Ruffed grouse
Bird	Galliformes	Phasianidae	*Lagopus lagopus*	Willow ptarmigan
Bird	Galliformes	Phasianidae	*Lagopus leucura*	White-tailed Ptarmigan
Bird	Galliformes	Phasianidae	*Lagopus muta*	Rock Ptarmigan
Bird	Gaviiformes	Gaviidae	*Gavia adamsii*	Yellow-billed loon
Bird	Gaviiformes	Gaviidae	*Gavia immer*	Common loon
Bird	Gaviiformes	Gaviidae	*Gavia pacifica*	Pacific loon
Bird	Gaviiformes	Gaviidae	*Gavia stellata*	Red-throated loon
Bird	Gruiformes	Gruidae	*Grus canadensis*	Sandhill crane
Bird	Passeriformes	Alaudidae	*Eremophila alpestris*	Horned lark
Bird	Passeriformes	Bombycillidae	*Bombycilla garrulus*	Bohemian wagwing

Denali Biosphere Region Species List - Fauna, *continued*

Category	Order	Family	Scientific Name	Common Names
Bird	Passeriformes	Calcariidae	*Calcarius lapponicus*	Lapland longspur
Bird	Passeriformes	Calcariidae	*Plectrophenax nivalis*	Snow bunting
Bird	Passeriformes	Cardinalidae	*Piranga ludoviciana*	Western tanager
Bird	Passeriformes	Certhiidae	*Certhia americana*	Brown creeper
Bird	Passeriformes	Cinclidae	*Cinclus mexicanus*	American dipper
Bird	Passeriformes	Corvidae	*Corvus corax*	Common raven
Bird	Passeriformes	Corvidae	*Cyanocitta stelleri*	Steller's jay
Bird	Passeriformes	Corvidae	*Perisoreus canadensis*	Gray jay
Bird	Passeriformes	Corvidae	*Pica hudsonia*	Black-billed Magpie
Bird	Passeriformes	Emberizidae	*Junco hyemalis*	Dark-eyed junco
Bird	Passeriformes	Emberizidae	*Passerculus sandwichensis*	Savannah sparrow
Bird	Passeriformes	Emberizidae	*Passerella iliaca*	Fox sparrow
Bird	Passeriformes	Emberizidae	*Spizella arborea*	American tree sparrow
Bird	Passeriformes	Emberizidae	*Zonotrichia atricapilla*	Golden-crowned sparrow
Bird	Passeriformes	Emberizidae	*Zonotrichia leucophrys*	White-crowned sparrow
Bird	Passeriformes	Fringillidae	*Carduelis flammea*	Common redpoll
Bird	Passeriformes	Fringillidae	*Carduelis hornemanni*	Hoary redpoll
Bird	Passeriformes	Fringillidae	*Carduelis pinus*	Pine siskin
Bird	Passeriformes	Fringillidae	*Leucosticte arctous*	Rosy Finch
Bird	Passeriformes	Fringillidae	*Leucosticte tephrocotis*	Gray-crowned rosy finch
Bird	Passeriformes	Fringillidae	*Loxia leucoptera*	White-winged crossbill
Bird	Passeriformes	Fringillidae	*Pinicola enucleator*	Pine grosbeak
Bird	Passeriformes	Hirundinidae	*Petrochelidon pyrrhonota*	Cliff Swallow
Bird	Passeriformes	Hirundinidae	*Riparia riparia*	Bank swallow
Bird	Passeriformes	Hirundinidae	*Tachycineta bicolor*	Tree swallow
Bird	Passeriformes	Hirundinidae	*Tachycineta thalassina*	Violet-green swallow
Bird	Passeriformes	Icteridae	*Agelaius phoeniceus*	Red-winged blackbird
Bird	Passeriformes	Icteridae	*Euphagus carolinus*	Rusty blackbird
Bird	Passeriformes	Icteridae	*Molothrus ater*	Brown-headed cowbird
Bird	Passeriformes	Laniidae	*Lanius excubitor*	Northern shrike
Bird	Passeriformes	Motacillidae	*Anthus spinoletta*	American pipit, Water pipit
Bird	Passeriformes	Motacillidae	*Motacilla tschutschensis*	Eastern Yellow Wagtail
Bird	Passeriformes	Muscicapidae	*Oenanthe oenanthe*	Northern wheatear
Bird	Passeriformes	Muscicapidae	*Phyllocopus borealis*	Arctic Warbler
Bird	Passeriformes	Parulidae	*Dendroica coronata*	Yellow-rumped warbler
Bird	Passeriformes	Parulidae	*Dendroica petechia*	Yellow warbler
Bird	Passeriformes	Parulidae	*Dendroica striata*	Blackpoll warbler
Bird	Passeriformes	Parulidae	*Dendroica townsendi*	Townsend's warbler
Bird	Passeriformes	Parulidae	*Seiurus noveboracensis*	Northern waterthrush
Bird	Passeriformes	Parulidae	*Setophaga ruticilla*	American redstart
Bird	Passeriformes	Parulidae	*Vermivora celata*	Orange-crowned warbler
Bird	Passeriformes	Parulidae	*Wilsonia pusilla*	Wilson's warbler
Bird	Passeriformes	Phylloscopidae	*Phylloscopus borealis*	Arctic warbler

Denali Biosphere Region Species List - Fauna, *continued*

Category	Order	Family	Scientific Name	Common Names
Bird	Passeriformes	Regulidae	*Regulus calendula*	Ruby-crowned kinglet
Bird	Passeriformes	Regulidae	*Regulus satrapa*	Golden-crowned kinglet
Bird	Passeriformes	Sittidae	*Sitta canadensis*	Red-breasted nuthatch
Bird	Passeriformes	Sturnidae	*Sturnus vulgaris*	European starling
Bird	Passeriformes	Turdidae	*Catharus guttatus*	Hermit thrush
Bird	Passeriformes	Turdidae	*Catharus minimus*	Gray-cheeked thrush
Bird	Passeriformes	Turdidae	*Catharus ustulatus*	Swainson's thrush
Bird	Passeriformes	Turdidae	*Ixoreus naevius*	Varied thrush
Bird	Passeriformes	Turdidae	*Myadestes townsendi*	Townsend's solitaire
Bird	Passeriformes	Turdidae	*Turdus migratorius*	American robin
Bird	Passeriformes	Tyrannidae	*Contopus cooperi*	Olive-sided Flycatcher
Bird	Passeriformes	Tyrannidae	*Contopus sordidulus*	Western wood-pewee
Bird	Passeriformes	Tyrannidae	*Empidonax alnorum*	Alder flycatcher
Bird	Passeriformes	Tyrannidae	*Empidonax hammondii*	Hammond's Flycatcher
Bird	Passeriformes	Tyrannidae	*Sayornis saya*	Say's phoebe
Bird	Piciformes	Picidae	*Colaptes auratus*	Northern flicker
Bird	Piciformes	Picidae	*Picoides arcticus*	Black-backed woodpecker
Bird	Piciformes	Picidae	*Picoides dorsalis*	American Three-toed Woodpecker
Bird	Piciformes	Picidae	*Picoides pubescens*	Downy woodpecker
Bird	Piciformes	Picidae	*Picoides villosus*	Hairy woodpecker
Bird	Podicipediformes	Podicipedidae	*Podiceps auritus*	Horned grebe
Bird	Podicipediformes	Podicipedidae	*Podiceps grisegena*	Red-necked grebe
Bird	Strigiformes	Strigidae	*Aegolius funereus*	Boreal owl
Bird	Strigiformes	Strigidae	*Asio flammeus*	Short-eared owl
Bird	Strigiformes	Strigidae	*Bubo scandiaca*	Snowy Owl
Bird	Strigiformes	Strigidae	*Bubo virginianus*	Great horned owl
Bird	Strigiformes	Strigidae	*Strix nebulosa*	Great gray owl
Bird	Strigiformes	Strigidae	*Surnia ulula*	Northern hawk owl
Amphibian	Anura	Ranidae	*Rana sylvatica*	Wood frog
Fish	Cypriniformes	Catostomidae	*Catostomus catostomus*	Longnose sucker
Fish	Esociformes	Esocidae	*Esox lucius*	Northern pike
Fish	Gadiformes	Gadidae	*Lota lota*	Burbot
Fish	Salmoniformes	Salmonidae	*Coregonus sardinella*	Least cisco
Fish	Salmoniformes	Salmonidae	*Oncorhynchus keta*	Chum salmon
Fish	Salmoniformes	Salmonidae	*Oncorhynchus kisutch*	Coho salmon
Fish	Salmoniformes	Salmonidae	*Oncorhynchus tshawytscha*	Chinook salmon
Fish	Salmoniformes	Salmonidae	*Prosopium cylindraceum*	Round whitefish
Fish	Salmoniformes	Salmonidae	*Salvelinus alpinus*	Arctic char
Fish	Salmoniformes	Salmonidae	*Salvelinus malma*	Dolly varden
Fish	Salmoniformes	Salmonidae	*Salvelinus namaycush*	Lake trout
Fish	Salmoniformes	Salmonidae	*Stenodus leucichthys*	Inconnu
Fish	Salmoniformes	Salmonidae	*Thymallus arcticus*	Arctic grayling
Fish	Scorpaeniformes	Cottidae	*Cottus cognatus*	Slimy sculpin

Denali Biosphere Region Species List- Flora

Family	Scientific Name	Life Form
Adoxaceae	*Adoxa moschatellina*	Herb / Forb
Apiaceae	*Angelica genuflexa*	Herb / Forb
	Angelica lucida	Herb / Forb
	Bupleurum americanum	Herb / Forb
	Cicuta bulbifera	Herb / Forb
	Cicuta douglasii	Herb / Forb
	Cicuta virosa	Herb / Forb
	Cnidium cnidiifolium	Herb / Forb
	Heracleum lanatum	Herb / Forb
	Osmorhiza depauperata	Herb / Forb
	Podistera macounii	Herb / Forb
Araceae	*Calla palustris*	Herb / Forb
Araliaceae	*Oplopanax horridus*	Herb / Forb
Asteraceae	*Achillea millefolium ssp. borealis*	Herb / Forb
	Achillea millefolium ssp. lanulosa	Herb / Forb
	Achillea millefolium ssp. millefolium	Herb / Forb
	Achillea sibirica	Herb / Forb
	Anaphalis margaritacea	Herb / Forb
	Antennaria alpina	Herb / Forb
	Antennaria friesiana	Herb / Forb
	Antennaria monocephala	Herb / Forb
	Antennaria pulcherrima	Herb / Forb
	Antennaria rosea	Herb / Forb
	Arnica amplexicaulis	Herb / Forb
	Arnica angustifolia	Herb / Forb
	Arnica ovata	Herb / Forb
	Arnica frigida ssp. griscomii	Herb / Forb
	Arnica latifolia	Herb / Forb
	Arnica lessingii	Herb / Forb
	Artemisia arctica	Herb / Forb
	Artemisia borealis	Herb / Forb
	Artemisia frigida	Herb / Forb
	Artemisia furcata	Herb / Forb
	Artemisia globularia	Herb / Forb
	Artemisia tilesii	Herb / Forb
	Bidens cernua	Herb / Forb
	Bidens tripartita	Herb / Forb
	Crepis elegans	Herb / Forb
	Crepis nana	Herb / Forb
	Crepis tectorum	Herb / Forb
	Erigeron acris	Herb / Forb
	Erigeron denalii	Herb / Forb
	Erigeron elatus	Herb / Forb
	Erigeron glabellus	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Erigeron porsildii	Herb / Forb
	Erigeron humilis	Herb / Forb
	Erigeron lonchophyllus	Herb / Forb
	Erigeron pallens	Herb / Forb
	Erigeron peregrinus	Herb / Forb
	Erigeron purpuratus	Herb / Forb
	Eurybia sibirica	Herb / Forb
	Hieracium triste	Herb / Forb
	*Hieracium umbellatum**	Herb / Forb
	Leucanthemum integrifolium	Herb / Forb
	Leucanthemum vulgare	Herb / Forb
	*Matricaria discoidea**	Herb / Forb
	Matricaria matricarioides	Herb / Forb
	Packera cymbalaria	Herb / Forb
	Packera ogotorukensis	Herb / Forb
	Packera pauciflora	Herb / Forb
	Packera paupercula	Herb / Forb
	Petasites frigidus	Herb / Forb
	Saussurea angustifolia	Herb / Forb
	Senecio congestus	Herb / Forb
	Senecio lugens	Herb / Forb
	Senecio triangularis	Herb / Forb
	Solidago canadensis var. lepida	Herb / Forb
	Solidago multiradiata	Herb / Forb
	*Sonchus arvensis**	Herb / Forb
	Symphyotrichum boreale	Herb / Forb
	Symphyotrichum subspicatum	Herb / Forb
	Taraxacum alaskanum	Herb / Forb
	Taraxacum carneocoloratum	Herb / Forb
	Taraxacum ceratophorum	Herb / Forb
	Taraxacum kamtschaticum	Herb / Forb
	Taraxacum lacerum	Herb / Forb
	*Taraxacum officinale**	Herb / Forb
	Taraxacum phymatocarpum	Herb / Forb
	Tephroseris atropurpurea	Herb / Forb
	Tephroseris kjellmanii	Herb / Forb
	Tephroseris lindstroemii	Herb / Forb
	Tephroseris yukonensis	Herb / Forb
	*Tripleurospermum inodorum**	Herb / Forb
Balsaminaceae	*Impatiens noli-tangere*	Herb / Forb
Betulaceae	*Alnus tenuifolia*	Shrub
	Alnus viridis	Shrub
	Betula kenaica	Tree

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Betula nana	Shrub
	Betula neoalaskana	Tree
	Betula occidentalis	Shrub
Boraginaceae	*Eritrichium aretioides*	Herb / Forb
	Eritrichium splendens	Herb / Forb
	*Lappula squarrosa**	Herb / Forb
	Mertensia paniculata	Herb / Forb
	Myosotis alpestris	Herb / Forb
	*Myosotis scorpioides**	Herb / Forb
Brassicaceae	*Aphragmus eschscholtzianus*	Herb / Forb
	Boechera stricta	Herb / Forb
	Arabis hirsuta	Herb / Forb
	Arabis holboellii	Herb / Forb
	Arabidopsis kamchatica	Herb / Forb
	Barbarea orthoceras	Herb / Forb
	Braya glabella	Herb / Forb
	*Capsella bursa-pastoris**	Herb / Forb
	Cardamine bellidifolia	Herb / Forb
	Cardamine oligosperma ssp. kamtschatica	Herb / Forb
	Cardamine pratensis	Herb / Forb
	Cardamine purpurea	Herb / Forb
	*Descurainia sophia**	Herb / Forb
	Descurainia sophioides	Herb / Forb
	Draba alpina	Herb / Forb
	Draba aurea	Herb / Forb
	Draba borealis	Herb / Forb
	Draba breweri	Herb / Forb
	Draba cinerea	Herb / Forb
	Draba corymbosa	Herb / Forb
	Draba crassifolia	Herb / Forb
	Draba densifolia	Herb / Forb
	Draba fladnizensis	Herb / Forb
	Draba glabella	Herb / Forb
	Draba lactea	Herb / Forb
	Draba lonchocarpa	Herb / Forb
	Draba longipes	Herb / Forb
	Draba macounii	Herb / Forb
	Draba nemorosa	Herb / Forb
	Draba nivalis	Herb / Forb
	Draba ruaxes	Herb / Forb
	Draba stenoloba	Herb / Forb
	Draba stenopetala	Herb / Forb
	*Erysimum cheiranthoides**	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Erysimum inconspicuum	Herb / Forb
	Erysimum pallasii	Herb / Forb
	Eutrema edwardsii	Herb / Forb
	Halimolobos mollis	Herb / Forb
	*Lepidium densiflorum**	Herb / Forb
	Lesquerella arctica	Herb / Forb
	Parrya nudicaulis	Herb / Forb
	Rorippa barbareifolia	Herb / Forb
	Rorippa palustris	Herb / Forb
	Smelowskia borealis	Herb / Forb
	Smelowskia calycina	Herb / Forb
	Subularia aquatica	Herb / Forb
	Thlaspi arcticum	Herb / Forb
Callitrichaceae	*Callitriche anceps*	Herb / Forb
	Callitriche hermaphroditica	Herb / Forb
	Callitriche verna	Herb / Forb
Campanulaceae	*Campanula lasiocarpa*	Herb / Forb
	Campanula uniflora	Herb / Forb
Caprifoliaceae	*Linnaea borealis*	Herb / Forb
	Sambucus racemosa	Shrub
	Viburnum edule	Shrub
Caryophyllaceae	*Arenaria capillaris*	Herb / Forb
	Arenaria longipedunculata	Herb / Forb
	Cerastium beeringianum	Herb / Forb
	Minuartia arctica	Herb / Forb
	Minuartia biflora	Herb / Forb
	Minuartia dawsonensis	Herb / Forb
	Minuartia elegans	Herb / Forb
	Minuartia macrocarpa	Herb / Forb
	Minuartia obtusiloba	Herb / Forb
	Minuartia rubella	Herb / Forb
	Minuartia yukonensis	Herb / Forb
	Moehringia lateriflora	Herb / Forb
	Sagina nivalis	Herb / Forb
	Sagina saginoides	Herb / Forb
	Silene acaulis	Herb / Forb
	Silene involucrata ssp. involucrata	Herb / Forb
	Silene involucrata ssp. tenella	Herb / Forb
	Silene macrosperma	Herb / Forb
	*Silene noctiflora**	Herb / Forb
	Silene repens	Herb / Forb
	Silene uralensis	Herb / Forb
	Silene williamsii	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Stellaria alaskana	Herb / Forb
	Stellaria borealis	Herb / Forb
	Stellaria calycantha	Herb / Forb
	Stellaria crassifolia	Herb / Forb
	Stellaria crispa	Herb / Forb
	Stellaria dicranoides	Herb / Forb
	Stellaria longifolia	Herb / Forb
	Stellaria longipes	Herb / Forb
	Stellaria umbellata	Herb / Forb
	Wilhelmsia physodes	Herb / Forb
Ceratophyllaceae	*Ceratophyllum demersum*	Herb / Forb
Chenopodiaceae	*Chenopodium album**	Herb / Forb
	Chenopodium capitatum	Herb / Forb
	Monolepis nuttalliana	Herb / Forb
Convolvulaceae	*Convolvulus arvensis**	Herb / Forb
Cornaceae	*Cornus canadensis*	Herb / Forb
	Cornus stolonifera	Shrub
	Cornus suecica	Herb / Forb
	Cornus unalaschkensis	Herb / Forb
Crassulaceae	*Rhodiola integrifolia*	Herb / Forb
Cupressaceae	*Juniperus communis*	Shrub
Cyperaceae	*Carex adelostoma*	Graminoid
	Carex albonigra	Graminoid
	Carex anthoxanthea	Graminoid
	Carex aquatilis	Graminoid
	Carex arcta	Graminoid
	Carex atherodes	Graminoid
	Carex atrofusca	Graminoid
	Carex atrosquama	Graminoid
	Carex aurea	Graminoid
	Carex bicolor	Graminoid
	Carex bigelowii	Graminoid
	Carex bonanzensis	Graminoid
	Carex brunnescens	Graminoid
	Carex buxbaumii	Graminoid
	Carex canescens	Graminoid
	Carex capillaris	Graminoid
	Carex capitata	Graminoid
	Carex chordorrhiza	Graminoid
	Carex concinna	Graminoid
	Carex crawfordii	Graminoid
	Carex deflexa	Graminoid
	Carex diandra	Graminoid

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Carex disperma	Graminoid
	Carex eburnea	Graminoid
	Carex echinata	Graminoid
	Carex eleusinoides	Graminoid
	Carex fuliginosa	Graminoid
	Carex garberi	Graminoid
	Carex incurviformis	Graminoid
	Carex interior	Graminoid
	Carex krausei	Graminoid
	Carex lachenalii	Graminoid
	Carex laeviculmis	Graminoid
	Carex lapponica	Graminoid
	Carex lasiocarpa	Graminoid
	Carex lenticularis var. lipocarpa	Graminoid
	Carex leptalea	Graminoid
	Carex limosa	Graminoid
	Carex livida	Graminoid
	Carex loliacea	Graminoid
	Carex lyngbyei	Graminoid
	Carex macrochaeta	Graminoid
	Carex magellanica	Graminoid
	Carex media	Graminoid
	Carex membranacea	Graminoid
	Carex mertensii	Graminoid
	Carex microchaeta	Graminoid
	Carex microglochin	Graminoid
	Carex nardina	Graminoid
	Carex nigricans	Graminoid
	Carex obtusata	Graminoid
	Carex pachystachya	Graminoid
	Carex parryana	Graminoid
	Carex pauciflora	Graminoid
	Carex petricosa	Graminoid
	Carex phaeocephala	Graminoid
	Carex pluriflora	Graminoid
	Carex podocarpa	Graminoid
	Carex praticola	Graminoid
	Carex rariflora	Graminoid
	Carex rostrata	Graminoid
	Carex rotundata	Graminoid
	Carex rupestris	Graminoid
	Carex saxatilis	Graminoid
	Carex scirpoidea	Graminoid

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Carex spectabilis	Graminoid
	Carex stylosa	Graminoid
	Carex supina	Graminoid
	Carex tenuiflora	Graminoid
	Carex utriculata	Graminoid
	Carex vaginata	Graminoid
	Carex viridula	Graminoid
	Carex williamsii	Graminoid
	Eleocharis acicularis	Graminoid
	Eleocharis palustris	Graminoid
	Eleocharis quinqueflora	Graminoid
	Eriophorum angustifolium	Graminoid
	Eriophorum brachyantherum	Graminoid
	Eriophorum callitrix	Graminoid
	Eriophorum chamissonis	Graminoid
	Eriophorum gracile	Graminoid
	Eriophorum scheuchzeri	Graminoid
	Eriophorum vaginatum	Graminoid
	Eriophorum viridicarinatum	Graminoid
	Kobresia myosuroides	Graminoid
	Kobresia sibirica	Graminoid
	Kobresia simpliciuscula	Graminoid
	Schoenoplectus tabernaemontani	Graminoid
	Scirpus microcarpus	Graminoid
	Trichophorum alpinum	Graminoid
	Trichophorum caespitosum	Graminoid
Diapensiaceae	*Diapensia lapponica*	Dwarf Shrub
Droseraceae	*Drosera anglica*	Herb / Forb
	Drosera rotundifolia	Herb / Forb
Dryopteridaceae	*Athyrium alpestre*	Fern
	Athyrium filix-femina	Fern
	Cystopteris fragilis	Fern
	Cystopteris montana	Fern
	Dryopteris expansa	Fern
	Dryopteris fragrans	Fern
	Gymnocarpium dryopteris	Fern
	Matteuccia struthiopteris	Fern
	Polystichum braunii	Fern
	Polystichum lonchitis	Fern
	Woodsia alpina	Fern
	Woodsia glabella	Fern
	Woodsia ilvensis	Fern
Elaeagnaceae	*Elaeagnus commutata*	Shrub

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Shepherdia canadensis	Shrub
Empetraceae	*Empetrum nigrum*	Dwarf Shrub
Equisetaceae	*Equisetum arvense*	Horsetail
	Equisetum fluviatile	Horsetail
	Equisetum palustre	Horsetail
	Equisetum pratense	Horsetail
	Equisetum scirpoides	Horsetail
	Equisetum sylvaticum	Horsetail
	Equisetum variegatum	Horsetail
Ericaceae	*Andromeda polifolia*	Shrub
	Arctostaphylos alpina	Dwarf Shrub
	Arctostaphylos rubra	Dwarf Shrub
	Arctostaphylos uva-ursi	Dwarf Shrub
	Cassiope lycopodioides	Dwarf Shrub
	Cassiope tetragona	Dwarf Shrub
	Chamaedaphne calyculata	Shrub
	Harrimanella stelleriana	Dwarf Shrub
	Loiseleuria procumbens	Dwarf Shrub
	Oxycoccus microcarpus	Dwarf Shrub
	Phyllodoce aleutica	Dwarf Shrub
	Phyllodoce caerulea	Dwarf Shrub
	Rhododendron camtschaticum	Dwarf Shrub
	Rhododendron groenlandicum	Shrub
	Rhododendron lapponicum	Shrub
	Rhododendron tomentosum ssp. decumbens	Shrub
	Vaccinium alaskensis	Shrub
	Vaccinium caespitosum	Shrub
	Vaccinium ovalifolium	Shrub
	Vaccinium uliginosum	Shrub
	Vaccinium vitis-idaea	Dwarf Shrub
Fabaceae	*Astragalus adsurgens*	Herb / Forb
	Astragalus alpinus	Herb / Forb
	Astragalus australis	Herb / Forb
	Astragalus eucosmus	Herb / Forb
	Astragalus nutzotinensis	Herb / Forb
	Astragalus polaris	Herb / Forb
	Astragalus robbinsii	Herb / Forb
	Astragalus umbellatus	Herb / Forb
	*Caragana arborescens**	Shrub
	Hedysarum alpinum	Herb / Forb
	Hedysarum boreale ssp. mackenzii	Herb / Forb
	Lupinus arcticus	Herb / Forb
	Lupinus nootkatensis	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	*Lupinus polyphyllus**	Herb / Forb
	*Melilotus albus**	Herb / Forb
	*Melilotus officinalis**	Herb / Forb
	Oxytropis borealis	Herb / Forb
	Oxytropis campestris	Herb / Forb
	Oxytropis deflexa	Herb / Forb
	Oxytropis huddelsonii	Herb / Forb
	Oxytropis maydelliana	Herb / Forb
	Oxytropis mertensiana	Herb / Forb
	Oxytropis nigrescens	Herb / Forb
	Oxytropis scammaniana	Herb / Forb
	*Trifolium hybridum**	Herb / Forb
	*Trifolium pratense**	Herb / Forb
	*Trifolium repens**	Herb / Forb
	*Vicia cracca**	Herb / Forb
Fumariaceae	*Corydalis aurea*	Herb / Forb
	Corydalis pauciflora	Herb / Forb
	Corydalis sempervirens	Herb / Forb
Gentianaceae	*Gentiana algida*	Herb / Forb
	Gentiana douglasiana	Herb / Forb
	Gentiana glauca	Herb / Forb
	Gentiana prostrata	Herb / Forb
	Gentianella amarella	Herb / Forb
	Gentianella propinqua	Herb / Forb
	Gentianella tenella	Herb / Forb
	Gentianopsis detonsa	Herb / Forb
	Lomatogonium rotatum	Herb / Forb
	Menyanthes trifoliata	Herb / Forb
	Swertia perennis	Herb / Forb
Geraniaceae	*Geranium erianthum*	Herb / Forb
Haloragaceae	*Hippuris montana*	Herb / Forb
	Hippuris vulgaris	Herb / Forb
	Myriophyllum sibiricum	Herb / Forb
	Myriophyllum verticillatum	Herb / Forb
Iridaceae	*Iris setosa*	Herb / Forb
Isoetaceae	*Isoetes echinospora*	Herb / Forb
	Isoetes occidentalis	Herb / Forb
Juncaceae	*Juncus alpinoarticulatus*	Graminoid
	Juncus arcticus	Graminoid
	Juncus biglumis	Graminoid
	Juncus bufonius	Graminoid
	Juncus castaneus	Graminoid
	Juncus drummondii	Graminoid

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Juncus filiformis	Graminoid
	Juncus mertensianus	Graminoid
	Juncus stygius	Graminoid
	Juncus supiniformis	Graminoid
	Juncus triglumis	Graminoid
	Luzula arctica	Graminoid
	Luzula arcuata	Graminoid
	Luzula confusa	Graminoid
	Luzula kjellmaniana	Graminoid
	Luzula multiflora	Graminoid
	Luzula parviflora	Graminoid
	Luzula piperi	Graminoid
	Luzula rufescens	Graminoid
	Luzula spicata	Graminoid
	Luzula wahlenbergii	Graminoid
	Triglochin maritima	Graminoid
Juncaginaceae	*Triglochin palustris*	Graminoid
Lamiaceae	*Galeopsis bifida**	Herb / Forb
	Scutellaria galericulata	Herb / Forb
Lemnaceae	*Lemna minor*	Herb / Forb
	Lemna trisulca	Herb / Forb
Lentibulariaceae	*Pinguicula villosa*	Herb / Forb
	Pinguicula vulgaris	Herb / Forb
	Utricularia intermedia	Herb / Forb
	Utricularia minor	Herb / Forb
	Utricularia vulgaris	Herb / Forb
Liliaceae	*Allium schoenoprasum*	Herb / Forb
	Fritillaria camschatcensis	Herb / Forb
	Lloydia serotina	Herb / Forb
	Maianthemum stellatum	Herb / Forb
	Streptopus amplexifolius	Herb / Forb
	Tofieldia coccinea	Herb / Forb
	Tofieldia glutinosa	Herb / Forb
	Tofieldia pusilla	Herb / Forb
	Veratrum viride	Herb / Forb
	Zygadenus elegans	Herb / Forb
	Linum lewisii	Herb / Forb
Lycopodiaceae	*Diphasiastrum alpinum*	Lycophyte
	Diphasiastrum complanatum	Lycophyte
	Diphasiastrum sitchense	Lycophyte
	Huperzia haleakalae	Lycophyte
	Lycopodium annotinum	Lycophyte
	Lycopodium clavatum	Lycophyte

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Lycopodium dendroideum	Lycophyte
	Lycopodium lagopus	Lycophyte
Myricaceae	*Myrica gale*	Shrub
Najadaceae	*Najas flexilis*	Herb / Forb
Nymphaceae	*Nuphar polysepala*	Herb / Forb
	Nymphaea tetragona	Herb / Forb
Onagraceae	*Chamerion angustifolium*	Herb / Forb
	Chamerion latifolium	Herb / Forb
	Circaea alpina	Herb / Forb
	Epilobium anagallidifolium	Herb / Forb
	Epilobium ciliatum	Herb / Forb
	Epilobium davuricum	Herb / Forb
	Epilobium hornemannii	Herb / Forb
	Epilobium lactiflorum	Herb / Forb
	Epilobium leptocarpum	Herb / Forb
	Epilobium luteum	Herb / Forb
	Epilobium palustre	Herb / Forb
Ophioglossaceae	*Botrychium alaskaense*	Fern
	Botrychium ascendens	Fern
	Botrychium lanceolatum	Fern
	Botrychium campestris var. lineare	Fern
	Botrychium lunaria	Fern
	Botrychium minganense	Fern
	Botrychium pinnatum	Fern
	Botrychium tunux	Fern
	Botrychium virginianum	Fern
	Botrychium yaaxudakeit	Fern
Orchidaceae	*Amerorchis rotundifolia*	Herb / Forb
	Calypso bulbosa	Herb / Forb
	Coeloglossum viride	Herb / Forb
	Corallorrhiza trifida	Herb / Forb
	Cypripedium guttatum	Herb / Forb
	Cypripedium passerinum	Herb / Forb
	Goodyera repens	Herb / Forb
	Listera borealis	Herb / Forb
	Listera cordata	Herb / Forb
	Malaxis monophylla	Herb / Forb
	Malaxis paludosa	Herb / Forb
	Platanthera dilatata	Herb / Forb
	Platanthera hyperborea	Herb / Forb
	Platanthera obtusata	Herb / Forb
	Platanthera stricta	Herb / Forb
	Spiranthes romanzoffiana	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
Orobanchaceae	*Boschniakia rossica*	Herb / Forb
Papaveraceae	*Papaver alboroseum*	Herb / Forb
	Papaver lapponicum	Herb / Forb
	Papaver macounii	Herb / Forb
	Papaver mcconnellii	Herb / Forb
	Papaver radicatum	Herb / Forb
Pinaceae	*Larix laricina*	Tree
	Picea glauca	Tree
	Picea mariana	Tree
Plantaginaceae	*Plantago major*	Herb / Forb
Poaceae	*Agrostis alaskana*	Graminoid
	Agrostis clavata	Graminoid
	Agrostis exarata	Graminoid
	Agrostis mertensii	Graminoid
	Agrostis scabra	Graminoid
	Agrostis scabra var. geminata	Graminoid
	Alopecurus aequalis	Graminoid
	Alopecurus alpinus	Graminoid
	Arctagrostis latifolia	Graminoid
	Arctophila fulva	Graminoid
	Beckmannia syzigachne	Graminoid
	Bromus ciliatus	Graminoid
	*Bromus inermis**	Graminoid
	Calamagrostis canadensis	Graminoid
	Calamagrostis lapponica	Graminoid
	Calamagrostis purpurascens	Graminoid
	Calamagrostis stricta	Graminoid
	Cinna latifolia	Graminoid
	Danthonia intermedia	Graminoid
	Deschampsia beringensis	Graminoid
	Deschampsia brevifolia	Graminoid
	Deschampsia caespitosa	Graminoid
	Elymus alaskanus	Graminoid
	Elymus macrourus	Graminoid
	Elymus repens	Graminoid
	Elymus trachycaulus	Graminoid
	Festuca altaica	Graminoid
	Festuca baffinensis	Graminoid
	Festuca brachyphylla	Graminoid
	Festuca brevissima	Graminoid
	Festuca lenensis	Graminoid
	Festuca richardsonii	Graminoid
	Festuca rubra	Graminoid

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Festuca saximontana	Graminoid
	Festuca vivipara	Graminoid
	Glyceria borealis	Graminoid
	Glyceria grandis	Graminoid
	Glyceria pulchella	Graminoid
	Glyceria striata	Graminoid
	Hierochlöe alpina	Graminoid
	Hierochlöe odorata	Graminoid
	*Hordeum jubatum**	Graminoid
	Leymus innovatus	Graminoid
	Phippsia algida	Graminoid
	Phleum alpinum	Graminoid
	Poa alpina	Graminoid
	Poa arctica	Graminoid
	Poa arctica subsp. lanata	Graminoid
	Poa glauca	Graminoid
	Poa macrocalyx	Graminoid
	Poa palustris	Graminoid
	Poa paucispicula	Graminoid
	Poa pratensis	Graminoid
	Poa pseudoabbreviata	Graminoid
	Podagrostis aequivalis	Graminoid
	Podagrostis thurberiana	Graminoid
	Puccinellia vahliana	Graminoid
	Schizachne purpurascens	Graminoid
	Trisetum spicatum	Graminoid
	Vahlodea atropurpurea	Graminoid
Polemoniaceae	*Phlox hoodii*	Herb / Forb
	Polemonium acutiflorum	Herb / Forb
	Polemonium boreale	Herb / Forb
	Polemonium pulcherrimum	Herb / Forb
Polygonaceae	*Fallopia convolvulus**	Herb / Forb
	Koenigia islandica	Herb / Forb
	Oxyria digyna	Herb / Forb
	Polygonum alaskanum	Herb / Forb
	Polygonum amphibium	Herb / Forb
	*Polygonum aviculare**	Herb / Forb
	Polygonum bistorta	Herb / Forb
	Polygonum lapathifolium	Herb / Forb
	Polygonum pennsylvanicum	Herb / Forb
	Polygonum viviparum	Herb / Forb
	Rumex acetosa	Herb / Forb
	Rumex arcticus	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Rumex maritimus	Herb / Forb
Polypodiaceae	*Polypodium sibiricum*	Fern
Portulacaceae	*Claytonia eschscholtzii*	Herb / Forb
	Claytonia sarmentosa	Herb / Forb
	Claytonia scammaniana	Herb / Forb
	Claytonia tuberosa	Herb / Forb
Potamogetonaceae	*Potamogeton alpinus*	Herb / Forb
	Potamogeton epihydrus	Herb / Forb
	Potamogeton foliosus	Herb / Forb
	Potamogeton friesii	Herb / Forb
	Potamogeton gramineus	Herb / Forb
	Potamogeton natans	Herb / Forb
	Potamogeton obtusifolius	Herb / Forb
	Potamogeton praelongus	Herb / Forb
	Potamogeton pusillus	Herb / Forb
	Potamogeton richardsonii	Herb / Forb
	Potamogeton subsibiricus	Herb / Forb
	Potamogeton zosteriformis	Herb / Forb
	Stuckenia filiformis	Herb / Forb
	Stuckenia pectinatus	Herb / Forb
Primulaceae	*Androsace chamaejasme*	Herb / Forb
	Androsace septentrionalis	Herb / Forb
	Dodecatheon frigidum	Herb / Forb
	Douglasia alaskana	Herb / Forb
	Douglasia gormanii	Herb / Forb
	Lysimachia thyrsiflora	Herb / Forb
	Primula cuneifolia	Herb / Forb
	Primula egaliksensis	Herb / Forb
	Primula eximia	Herb / Forb
	Primula mistassinica	Herb / Forb
	Trientalis europaea	Herb / Forb
Pteridaceae	*Cryptogramma acrostichoides*	Fern
	Cryptogramma sitchensis	Fern
	Cryptogramma stelleri	Fern
Pyrolaceae	*Moneses uniflora*	Herb / Forb
	Orthilia secunda	Herb / Forb
	Pyrola asarifolia	Herb / Forb
	Pyrola chlorantha	Herb / Forb
	Pyrola grandiflora	Herb / Forb
	Pyrola minor	Herb / Forb
Ranunculaceae	*Aconitum delphiniifolium*	Herb / Forb
	Actaea rubra	Herb / Forb
	Anemone drummondii	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Anemone multiceps	Herb / Forb
	Anemone multifida	Herb / Forb
	Anemone narcissiflora	Herb / Forb
	Anemone parviflora	Herb / Forb
	Anemone richardsonii	Herb / Forb
	Caltha leptosepala	Herb / Forb
	Caltha natans	Herb / Forb
	Caltha palustris	Herb / Forb
	Coptis trifolia	Herb / Forb
	Delphinium brachycentrum	Herb / Forb
	Delphinium glaucum	Herb / Forb
	Pulsatilla patens	Herb / Forb
	Ranunculus cymbalaria	Herb / Forb
	Ranunculus eschscholtzii	Herb / Forb
	Ranunculus flammula	Herb / Forb
	Ranunculus gelidus	Herb / Forb
	Ranunculus gmelinii	Herb / Forb
	Ranunculus hyperboreus	Herb / Forb
	Ranunculus lapponicus	Herb / Forb
	Ranunculus macounii	Herb / Forb
	Ranunculus nivalis	Herb / Forb
	Ranunculus occidentalis	Herb / Forb
	Ranunculus pedatifidus	Herb / Forb
	Ranunculus pensylvanicus	Herb / Forb
	Ranunculus pygmaeus	Herb / Forb
	Ranunculus sceleratus	Herb / Forb
	Ranunculus sulphureus	Herb / Forb
	Ranunculus trichophyllus	Herb / Forb
	Thalictrum alpinum	Herb / Forb
	Thalictrum sparsiflorum	Herb / Forb
Rosaceae	*Comarum palustre*	Herb / Forb
	Dryas alaskensis	Dwarf Shrub
	Dryas drummondii	Dwarf Shrub
	Dryas integrifolia	Dwarf Shrub
	Dryas integrifolia ssp. sylvatica	Dwarf Shrub
	Dryas octopetala	Dwarf Shrub
	Geum glaciale	Herb / Forb
	Geum macrophyllum	Herb / Forb
	Geum rossii	Herb / Forb
	Luetkea pectinata	Herb / Forb
	Potentilla biflora	Herb / Forb
	Potentilla diversifolia	Herb / Forb
	Potentilla fruticosa	Shrub

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Potentilla hookeriana	Herb / Forb
	Potentilla hyparctica	Herb / Forb
	Potentilla littoralis	Herb / Forb
	Potentilla nivea	Herb / Forb
	Potentilla norvegica	Herb / Forb
	Potentilla pensylvanica	Herb / Forb
	Potentilla uniflora	Herb / Forb
	Rosa acicularis	Shrub
	Rubus arcticus	Herb / Forb
	Rubus chamaemorus	Herb / Forb
	Rubus idaeus	Shrub
	Rubus pedatus	Herb / Forb
	Rubus spectabilis	Shrub
	Sanguisorba canadensis ssp. latifolia	Herb / Forb
	Sanguisorba officinalis	Herb / Forb
	Sibbaldia procumbens	Herb / Forb
	Sorbus scopulina	Shrub
	Spiraea stevenii	Shrub
Rubiaceae	*Galium boreale*	Herb / Forb
	Galium brandegei	Herb / Forb
	Galium kamtschaticum	Herb / Forb
	Galium trifidum	Herb / Forb
	Galium triflorum	Herb / Forb
Salicaceae	*Populus balsamifera*	Tree
	Populus tremuloides	Tree
	Populus trichocarpa	Tree
	Salix alaxensis	Shrub
	Salix arbusculoides	Shrub
	Salix arctica	Dwarf Shrub
	Salix barclayi	Shrub
	Salix barrattiana	Shrub
	Salix bebbiana	Shrub
	Salix candida	Shrub
	Salix commutata	Shrub
	Salix exigua ssp. interior	Shrub
	Salix fuscescens	Shrub
	Salix glauca	Shrub
	Salix hastata	Shrub
	Salix lucida	Shrub
	Salix myrtillifolia	Shrub
	Salix niphoclada	Shrub
	Salix phlebophylla	Dwarf Shrub
	Salix polaris	Dwarf Shrub

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Salix pseudomonticola	Shrub
	Salix pseudomyrsinites	Shrub
	Salix pulchra	Shrub
	Salix reticulata	Dwarf Shrub
	Salix richardsonii	Shrub
	Salix rotundifolia	Dwarf Shrub
	Salix scouleriana	Shrub
	Salix setchelliana	Dwarf Shrub
	Salix sitchensis	Shrub
	Salix stolonifera	Dwarf Shrub
Santalaceae	*Geocaulon lividum*	Herb / Forb
Saxifragaceae	*Boykinia richardsonii*	Herb / Forb
	Chrysosplenium tetrandrum	Herb / Forb
	Chrysosplenium wrightii	Herb / Forb
	Heuchera glabra	Herb / Forb
	Leptarrhena pyrolifolia	Herb / Forb
	Mitella pentandra	Herb / Forb
	Parnassia kotzebuei	Herb / Forb
	Parnassia palustris	Herb / Forb
	Ribes glandulosum	Shrub
	Ribes hudsonianum	Shrub
	Ribes lacustre	Shrub
	Ribes laxiflorum	Shrub
	Ribes triste	Shrub
	Saxifraga adscendens	Herb / Forb
	Saxifraga bronchialis	Herb / Forb
	Saxifraga caespitosa	Herb / Forb
	Saxifraga calycina	Herb / Forb
	Saxifraga cernua	Herb / Forb
	Saxifraga eschscholtzii	Herb / Forb
	Saxifraga flagellaris	Herb / Forb
	Saxifraga foliolosa	Herb / Forb
	Saxifraga hieracifolia	Herb / Forb
	Saxifraga hirculus	Herb / Forb
	Saxifraga lyallii	Herb / Forb
	Micranthes posildiana	Herb / Forb
	Saxifraga nivalis	Herb / Forb
	Saxifraga oppositifolia	Herb / Forb
	Saxifraga reflexa	Herb / Forb
	Saxifraga rivularis	Herb / Forb
	Saxifraga serpyllifolia	Herb / Forb
	Saxifraga spicata	Herb / Forb
	Saxifraga tricuspidata	Herb / Forb

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
Scheuchzeriaceae	*Scheuchzeria palustris*	Graminoid
Scrophulariaceae	*Castilleja caudata*	Herb / Forb
	Castilleja elegans	Herb / Forb
	Euphrasia mollis	Herb / Forb
	Euphrasia subarctica	Herb / Forb
	Lagotis glauca	Herb / Forb
	Limosella aquatica	Herb / Forb
	*Linaria vulgaris**	Herb / Forb
	Mimulus guttatus	Herb / Forb
	Pedicularis capitata	Herb / Forb
	Pedicularis interior	Herb / Forb
	Pedicularis labradorica	Herb / Forb
	Pedicularis lanata	Herb / Forb
	Pedicularis langsdorffi	Herb / Forb
	Pedicularis macrodonta	Herb / Forb
	Pedicularis oederi	Herb / Forb
	Pedicularis verticillata	Herb / Forb
	Rhinanthus minor	Herb / Forb
	Synthyris borealis	Herb / Forb
	Veronica americana	Herb / Forb
	Veronica scutellata	Herb / Forb
	Veronica serpyllifolia	Herb / Forb
	Veronica wormskjoldii	Herb / Forb
Selaginellaceae	*Selaginella selaginoides*	Lycophyte
	Selaginella sibirica	Lycophyte
Sparganiaceae	*Sparganium angustifolium*	Herb / Forb
	Sparganium hyperboreum	Herb / Forb
	Sparganium natans	Herb / Forb
Thelypteridaceae	*Phegopteris connectilis*	Fern
Typhaceae	*Typha latifolia*	Graminoid
Urticaceae	*Urtica dioica*	Herb / Forb
Valerianaceae	*Valeriana capitata*	Herb / Forb
Violaceae	*Viola biflora*	Herb / Forb
	Viola epipsila	Herb / Forb
	Viola glabella	Herb / Forb
	Viola langsdorffii	Herb / Forb
	Viola selkirkii	Herb / Forb
Aneuraceae	*Aneura pinguis*	Liverwort
	Riccardia chamedryfolia	Liverwort
	Riccardia latifrons	Liverwort
Antheliaceae	*Anthelia julacea*	Liverwort
	Anthelia juratzkana	Liverwort
Aytoniaceae	*Asterella lindenbergiana*	Liverwort

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Mannia pilosa	Liverwort
Blasiaceae	*Blasia pusilla*	Liverwort
Calypogeiaceae	*Calypogeia azurea*	Liverwort
	Calypogeia fissa	Liverwort
	Calypogeia integristipula	Liverwort
	Calypogeia muelleriana	Liverwort
	Calypogeia neesiana	Liverwort
	Calypogeia sphagnicola	Liverwort
	Calypogeia suecica	Liverwort
Cephaloziaceae	*Cephalozia bicuspidata ssp. ambigua*	Liverwort
	Cephalozia bicuspidata ssp. bicuspidata	Liverwort
	Cephalozia bicuspidata	Liverwort
	Cephalozia connivens	Liverwort
	Cephalozia lunulifolia	Liverwort
	Cephalozia pleniceps	Liverwort
	Odontoschisma macounii	Liverwort
	Pleuroclada albescens	Liverwort
Cephaloziellaceae	*Cephaloziella arctica*	Liverwort
	Cephaloziella divaricata	Liverwort
	Cephaloziella divaricata var. divaricata	Liverwort
	Cephaloziella subdentata	Liverwort
Conocephalaceae	*Conocephalum conicum*	Liverwort
Fossombroniaceae	*Fossombronia foveolata*	Liverwort
Geocalycaceae	*Chiloscyphus pallescens*	Liverwort
	Lophocolea minor	Liverwort
Gymnomitriaceae	*Apomarsupella revoluta*	Liverwort
	Gymnomitrion concinnatum	Liverwort
	Gymnomitrion corallioides	Liverwort
	Gymnomitrium commutatum	Liverwort
	Marsupella apiculata	Liverwort
	Marsupella boeckii	Liverwort
	Marsupella emarginata	Liverwort
Herbertaceae	*Herbertus dicranus*	Liverwort
Jubulaceae	*Frullania tamarisci ssp. nisquallensis*	Liverwort
Jungermanniaceae	*Anastrophyllum assimile*	Liverwort
	Anastrophyllum minutum var. minutum	Liverwort
	Anastrophyllum minutum	Liverwort
	Anastrophyllum saxicola	Liverwort
	Barbilophozia atlantica	Liverwort
	Barbilophozia attenuata	Liverwort
	Barbilophozia barbata	Liverwort
	Barbilophozia binsteadii	Liverwort
	Barbilophozia floerkei	Liverwort

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Barbilophozia hatcheri	Liverwort
	Barbilophozia hyperborea	Liverwort
	Barbilophozia kunzeana	Liverwort
	Barbilophozia lycopodioides	Liverwort
	Barbilophozia quadriloba	Liverwort
	Chandonanthus setiformis	Liverwort
	Gymnocolea inflata	Liverwort
	Jungermannia atrovirens	Liverwort
	Jungermannia eucordifolia	Liverwort
	Leiocolea badensis	Liverwort
	Leiocolea bantriensis	Liverwort
	Leiocolea collaris	Liverwort
	Leiocolea gillmanii	Liverwort
	Leiocolea heterocolpos	Liverwort
	Leiocolea rutheana	Liverwort
	Lophozia bicrenata	Liverwort
	Lophozia excisa	Liverwort
	Lophozia longidens	Liverwort
	Lophozia obtusa	Liverwort
	Lophozia pellucida	Liverwort
	Lophozia perssonii	Liverwort
	Lophozia polaris	Liverwort
	Lophozia propagulifera	Liverwort
	Lophozia silvicola	Liverwort
	Lophozia sudetica	Liverwort
	Lophozia ventricosa var. longiflora	Liverwort
	Lophozia ventricosa var. ventricosa	Liverwort
	Lophozia ventricosa	Liverwort
	Lophozia wenzelii	Liverwort
	Mylia anomala	Liverwort
	Nardia compressa	Liverwort
	Nardia geoscyphus	Liverwort
	Nardia scalaris	Liverwort
	Schistochilopsis incisa var. opacifolia	Liverwort
	Schistochilopsis incisa	Liverwort
	Solenostoma confertissima	Liverwort
	Solenostoma rubrum	Liverwort
	Solenostoma sphaerocarpum	Liverwort
	Solenostoma subellipticum	Liverwort
	Tritomaria exsecta	Liverwort
	Tritomaria exsectiformis	Liverwort
	Tritomaria polita	Liverwort
	Tritomaria quinquedentata	Liverwort

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Tritomaria scitula	Liverwort
Lepidoziaceae	*Lepidozia reptans*	Liverwort
Marchantiaceae	*Preissia quadrata*	Liverwort
	Marchantia polymorpha	Liverwort
Mesoptychiaceae	*Mesoptychia sahlbergii*	Liverwort
Pallaviciniaceae	*Moerckia blyttii*	Liverwort
Pelliaceae	*Pellia endiviifolia*	Liverwort
	Pellia epiphylla	Liverwort
	Pellia neesiana	Liverwort
Plagiochilaceae	*Plagiochila porelloides*	Liverwort
Pseudolepicoleaceae	*Blepharostoma trichophyllum ssp. trichophyllum*	Liverwort
	Blepharostoma trichophyllum	Liverwort
Ptilidiaceae	*Ptilidium ciliare*	Liverwort
	Ptilidium pulcherrimum	Liverwort
Radulaceae	*Radula complanata*	Liverwort
	Radula prolifera	Liverwort
Scapaniaceae	*Diplophyllum taxifolium var. macrosticta*	Liverwort
	Diplophyllum taxifolium var. taxifolium	Liverwort
	Diplophyllum taxifolium	Liverwort
	Scapania curta	Liverwort
	Scapania cuspiduligera	Liverwort
	Scapania gymnostomophila	Liverwort
	Scapania irrigua	Liverwort
	Scapania paludicola	Liverwort
	Scapania paludosa	Liverwort
	Scapania plicata	Liverwort
	Scapania scandica	Liverwort
	Scapania subalpina	Liverwort
	Scapania uliginosa	Liverwort
	Scapania umbrosa	Liverwort
	Scapania undulata var. undulata	Liverwort
	Scapania undulata	Liverwort
Amblystegiaceae	*Amblystegium serpens*	Moss
	Campyliadelphus chrysophyllus	Moss
	Campylium protensum	Moss
	Campylium stellatum	Moss
	Cratoneuron filicinum	Moss
	Drepanocladus aduncus	Moss
	Drepanocladus longifolius	Moss
	Drepanocladus polygamus	Moss
	Drepanocladus sordidus	Moss
	Hygroamblystegium tenax	Moss
	Hygrohypnum cochlearifolium	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Hygrohypnum luridum	Moss
	Hygrohypnum norvegicum	Moss
	Hygrohypnum ochraceum	Moss
	Palustriella commutata	Moss
	Pseudocalliergon brevifolium	Moss
	Pseudocalliergon turgescens	Moss
	Sanionia orthothecioides	Moss
	Sanionia uncinata	Moss
Andreaeaceae	*Andreaea blyttii*	Moss
	Andreaea rupestris	Moss
Aulacomniaceae	*Aulacomnium acuminatum*	Moss
	Aulacomnium palustre	Moss
	Aulacomnium turgidum	Moss
Bartramiaceae	*Bartramia ithyphylla*	Moss
	Bartramia pomiformis	Moss
	Conostomum tetragonum	Moss
	Philonotis capillaris	Moss
	Philonotis fontana var. americana	Moss
	Philonotis fontana var. fontana	Moss
	Philonotis fontana var. pumila	Moss
	Philonotis fontana	Moss
	Plagiopus oederianus	Moss
Brachytheciaceae	*Brachythecium albicans*	Moss
	Brachythecium calcareum	Moss
	Brachythecium cirrosum	Moss
	Brachythecium collinum	Moss
	Brachythecium erythrorrhizon	Moss
	Brachythecium frigidum	Moss
	Brachythecium glareosum	Moss
	Brachythecium nelsonii	Moss
	Brachythecium oedipodium	Moss
	Brachythecium plumosum	Moss
	Brachythecium reflexum var. pacificum	Moss
	Brachythecium reflexum	Moss
	Brachythecium rivulare	Moss
	Brachythecium salebrosum	Moss
	Brachythecium starkei	Moss
	Brachythecium turgidum	Moss
	Eurhynchiastrum pulchellum var. pulchellum	Moss
	Eurhynchiastrum pulchellum	Moss
	Homalothecium fulgescens	Moss
	Tomentypnum nitens	Moss
Bryaceae	*Anomobryum julaceum*	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Bryum argenteum	Moss
	Bryum argenteum var. argenteum	Moss
	Gemmabryum caespiticium	Moss
	Leptobryum pyriforme	Moss
	Mielichhoferia mielichhoferiana var. elongata	Moss
	Plagiobryum demissum	Moss
	Pohlia andrewsii	Moss
	Pohlia annotina	Moss
	Pohlia beringiensis	Moss
	Pohlia bulbifera	Moss
	Pohlia columbica	Moss
	Pohlia cruda	Moss
	Pohlia crudoides	Moss
	Pohlia drummondii	Moss
	Pohlia filum	Moss
	Pohlia longicollis	Moss
	Pohlia nutans	Moss
	Pohlia obtusifolia	Moss
	Pohlia proligera	Moss
	Pohlia vexans	Moss
	Pohlia wahlenbergii	Moss
	Ptychostomum acutiforme	Moss
	Ptychostomum archangelicum	Moss
	Ptychostomum arcticum	Moss
	Ptychostomum calophyllum	Moss
	Ptychostomum creberrimum	Moss
	Ptychostomum cyclophyllum	Moss
	Ptychostomum inclinatum	Moss
	Ptychostomum lonchocaulon	Moss
	Ptychostomum pallescens	Moss
	Ptychostomum pendulum	Moss
	Ptychostomum pseudotriquetrum	Moss
	Ptychostomum turbinatum	Moss
	Rhodobryum roseum	Moss
	Rosulabryum capillare	Moss
	Rosulabryum elegans	Moss
	Mielichhoferia mielichhoferiana	Moss
	Ptychostomum weigelii	Moss
	Ptychostomum pallens	Moss
Buxbaumiaceae	*Buxbaumia aphylla*	Moss
Calliergonaceae	*Calliergon cordifolium*	Moss
	Calliergon giganteum	Moss
	Calliergon richardsonii	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Campylophyllum halleri	Moss
	Campylophyllum hispidulum	Moss
	Campylophyllum sommerfeltii	Moss
	Hamatocaulis vernicosus	Moss
	Loeskypnum badium	Moss
	Sarmentypnum sarmentosum	Moss
	Scorpidium cossonii	Moss
	Scorpidium revolvens	Moss
	Scorpidium scorpioides	Moss
	Straminergon stramineum	Moss
Campyliaceae	*Warnstorfia exannulata*	Moss
	Warnstorfia fluitans	Moss
	Warnstorfia pseudosarmentosa	Moss
	Warnstorfia pseudostraminea	Moss
	Warnstorfia tundrae	Moss
Catoscopiaceae	*Catoscopium nigritum*	Moss
Climaciaceae	*Climacium dendroides*	Moss
Dicranaceae	*Aongstroemia longipes*	Moss
	Arctoa fulvella	Moss
	Campylopus fragilis	Moss
	Campylopus schimperi	Moss
	Cynodontium alpestre	Moss
	Cynodontium polycarpon	Moss
	Cynodontium schisti	Moss
	Cynodontium strumiferum	Moss
	Cynodontium tenellum	Moss
	Dichodontium pellucidum	Moss
	Dicranella cerviculata	Moss
	Dicranella crispa	Moss
	Dicranella heteromalla	Moss
	Dicranella palustris	Moss
	Dicranella schreberiana	Moss
	Dicranella subulata	Moss
	Dicranella varia	Moss
	Dicranoweisia crispula	Moss
	Dicranum acutifolium	Moss
	Dicranum bonjeanii	Moss
	Dicranum elongatum	Moss
	Dicranum flagellare	Moss
	Dicranum fragilifolium	Moss
	Dicranum fuscescens	Moss
	Dicranum groenlandicum	Moss
	Dicranum howellii	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Dicranum majus	Moss
	Dicranum montanum	Moss
	Dicranum muehlenbeckii	Moss
	Dicranum pallidisetum	Moss
	Dicranum polysetum	Moss
	Dicranum scoparium	Moss
	Dicranum spadiceum	Moss
	Dicranum tauricum	Moss
	Dicranum undulatum	Moss
	Kiaeria falcata	Moss
	Kiaeria glacialis	Moss
	Kiaeria starkei	Moss
	Oncophorus virens	Moss
	Oncophorus wahlenbergii	Moss
	Paraleucobryum enerve	Moss
	Paraleucobryum longifolium	Moss
	Rhabdoweisia crispata	Moss
	Dicranum brevifolium	Moss
Ditrichaceae	*Ceratodon purpureus*	Moss
	Distichium capillaceum	Moss
	Distichium inclinatum	Moss
	Ditrichum flexicaule	Moss
	Ditrichum gracile	Moss
	Ditrichum heteromallum	Moss
	Saelania glaucescens	Moss
	Trichodon cylindricus var. cylindricus	Moss
	Trichodon cylindricus	Moss
Encalyptaceae	*Bryobrittonia longipes*	Moss
	Encalypta affinis	Moss
	Encalypta alpina	Moss
	Encalypta brevicollis	Moss
	Encalypta ciliata	Moss
	Encalypta longicollis	Moss
	Encalypta procera	Moss
	Encalypta rhaptocarpa	Moss
	Encalypta vulgaris	Moss
Entodontaceae	*Entodon concinnus*	Moss
Fissidentaceae	*Fissidens adianthoides*	Moss
	Fissidens bryoides	Moss
	Fissidens osmundioides	Moss
Fontinalaceae	*Dichelyma uncinatum*	Moss
Funariaceae	*Funaria hygrometrica*	Moss
Grimmiaceae	*Bucklandiella heterosticha*	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Bucklandiella sudetica	Moss
	Codriophorus acicularis	Moss
	Codriophorus corrugatus	Moss
	Codriophorus fascicularis	Moss
	Grimmia donniana	Moss
	Grimmia lisae	Moss
	Grimmia longirostris	Moss
	Grimmia mollis	Moss
	Grimmia ovalis	Moss
	Grimmia sessitana	Moss
	Grimmia torquata	Moss
	Niphotrichum canescens	Moss
	Niphotrichum elongatum	Moss
	Niphotrichum ericoides	Moss
	Racomitrium lanuginosum	Moss
	Schistidium agassizii	Moss
	Schistidium apocarpum	Moss
	Schistidium cryptocarpum	Moss
	Schistidium frigidum	Moss
	Schistidium papillosum	Moss
	Schistidium pulchrum	Moss
	Schistidium rivulare	Moss
	Schistidium strictum	Moss
	Schistidium tenerum	Moss
Hedwigiaceae	*Hedwigia ciliata*	Moss
Helodiaceae	*Helodium blandowii*	Moss
Hylocomiaceae	*Hylocomiastrum pyrenaicum*	Moss
	Hylocomium splendens	Moss
	Pleurozium schreberi	Moss
	Rhytidiadelphus triquetrus	Moss
	Rhytidiadelphus squarrosus	Moss
Hypnaceae	*Gollania turgens*	Moss
	Hypnum bambergeri	Moss
	Hypnum callichroum	Moss
	Hypnum cupressiforme var. subjulaceum	Moss
	Hypnum cupressiforme	Moss
	Hypnum dieckii	Moss
	Hypnum hamulosum	Moss
	Hypnum holmenii	Moss
	Hypnum lindbergii	Moss
	Hypnum plicatulum	Moss
	Hypnum pratense	Moss
	Hypnum procerrimum	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Hypnum revolutum var. revolutum	Moss
	Hypnum revolutum	Moss
	Hypnum revolutum var. ravaudii	Moss
	Hypnum subimponens	Moss
	Hypnum vaucheri	Moss
	Isopterygiopsis muelleriana	Moss
	Isopterygiopsis pulchella	Moss
	Orthothecium chryseum	Moss
	Orthothecium intricatum	Moss
	Platydictya jungermannioides	Moss
	Ptilium crista-castrensis	Moss
	Pylaisia polyantha	Moss
	Pylaisia selwynii	Moss
Leskeaceae	*Lescuraea saxicola*	Moss
	Leskeella nervosa	Moss
	Pseudoleskea incurvata var. incurvata	Moss
	Pseudoleskea patens	Moss
	Pseudoleskea radicosa var. radicosa	Moss
	Pseudoleskea stenophylla	Moss
	Pseudoleskeella rupestris	Moss
	Pseudoleskeella tectorum	Moss
	Leptopterigynandrum austroalpinum	Moss
	Pseudoleskea incurvata	Moss
	Pseudoleskea radicosa	Moss
Meesiaceae	*Meesia longiseta*	Moss
	Meesia triquetra	Moss
	Meesia uliginosa	Moss
	Paludella squarrosa	Moss
Mniaceae	*Cinclidium arcticum*	Moss
	Cinclidium stygium	Moss
	Cinclidium subrotundum	Moss
	Cyrtomnium hymenophyllum	Moss
	Mnium ambiguum	Moss
	Mnium blyttii	Moss
	Mnium hornum	Moss
	Mnium marginatum	Moss
	Mnium spinosum	Moss
	Mnium spinulosum	Moss
	Mnium thomsonii	Moss
	Plagiomnium cuspidatum	Moss
	Plagiomnium ellipticum	Moss
	Plagiomnium medium	Moss
	Plagiomnium rostratum	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Pseudobryum cinclidioides	Moss
	Rhizomnium andrewsianum	Moss
	Rhizomnium gracile	Moss
	Rhizomnium magnifolium	Moss
	Rhizomnium nudum	Moss
	Rhizomnium pseudopunctatum	Moss
	Rhizomnium punctatum	Moss
Neckeraceae	*Neckera pennata*	Moss
Orthotrichaceae	*Amphidium lapponicum*	Moss
	Orthotrichum consimile	Moss
	Orthotrichum obtusifolium	Moss
	Orthotrichum pellucidum	Moss
	Orthotrichum pylaisii	Moss
	Orthotrichum rupestre	Moss
	Orthotrichum speciosum	Moss
	Ulota curvifolia	Moss
	Ulota hutchinsiae var. hutchinsiae	Moss
	Ulota drummondii	Moss
	Ulota hutchinsiae	Moss
Plagiotheciaceae	*Plagiothecium cavifolium*	Moss
	Plagiothecium denticulatum	Moss
	Plagiothecium laetum	Moss
	Plagiothecium piliferum	Moss
Polytrichaceae	*Atrichum selwynii*	Moss
	Atrichum tenellum	Moss
	Meiotrichum lyallii	Moss
	Oligotrichum aligerum	Moss
	Oligotrichum falcatum	Moss
	Oligotrichum hercynicum	Moss
	Oligotrichum parallelum	Moss
	Pogonatum dentatum	Moss
	Pogonatum urnigerum	Moss
	Polytrichastrum alpinum var. alpinum	Moss
	Polytrichastrum alpinum	Moss
	Polytrichastrum formosum	Moss
	Polytrichastrum longisetum	Moss
	Polytrichastrum sexangulare var. sexangulare	Moss
	Polytrichastrum sexangulare	Moss
	Polytrichum commune var. commune	Moss
	Polytrichum commune	Moss
	Polytrichum hyperboreum	Moss
	Polytrichum jensenii	Moss
	Polytrichum juniperinum	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Polytrichum piliferum	Moss
	Polytrichum strictum	Moss
	Polytrichum swartzii	Moss
	Psilopilum cavifolium	Moss
Pottiaceae	*Aloina brevirostris*	Moss
	Anoectangium aestivum	Moss
	Barbula convoluta	Moss
	Barbula unguiculata	Moss
	Bryoerythrophyllum recurvirostrum	Moss
	Didymodon brachyphyllus	Moss
	Didymodon rigidulus var. gracilis	Moss
	Didymodon rigidulus var. icmadophilus	Moss
	Hymenostylium recurvirostrum var. recurvirostrum	Moss
	Hymenostylium recurvirostrum	Moss
	Pterygoneurum lamellatum	Moss
	Stegonia latifolia	Moss
	Syntrichia norvegica	Moss
	Syntrichia ruralis	Moss
	Tortella alpicola	Moss
	Tortella fragilis	Moss
	Tortella inclinata	Moss
	Tortella tortuosa var. fragilifolia	Moss
	Tortella tortuosa var. tortuosa	Moss
	Tortella tortuosa	Moss
	Tortula hoppeana	Moss
	Tortula leucostoma	Moss
	Tortula mucronifolia	Moss
	Tortula systylia	Moss
	Trichostomum arcticum	Moss
	Trichostomum tenuirostre var. tenuirostre	Moss
	Trichostomum tenuirostre	Moss
	Weissia controversa	Moss
Pterigynandraceae	*Iwatsukiella leucotricha*	Moss
	Myurella julacea	Moss
	Myurella sibirica	Moss
	Myurella tenerrima	Moss
Rhytidiaceae	*Rhytidium rugosum*	Moss
Scouleriaceae	*Scouleria aquatica*	Moss
Seligeriaceae	*Seligeria polaris*	Moss
Sphagnaceae	*Sphagnum andersonianum*	Moss
	Sphagnum angustifolium	Moss
	Sphagnum aongstroemii	Moss
	Sphagnum balticum	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Sphagnum brevifolium	Moss
	Sphagnum capillifolium	Moss
	Sphagnum compactum	Moss
	Sphagnum fallax	Moss
	Sphagnum fimbriatum	Moss
	Sphagnum fuscum	Moss
	Sphagnum girgensohnii	Moss
	Sphagnum lenense	Moss
	Sphagnum lindbergii	Moss
	Sphagnum magellanicum	Moss
	Sphagnum obtusum	Moss
	Sphagnum papillosum	Moss
	Sphagnum platyphyllum	Moss
	Sphagnum riparium	Moss
	Sphagnum rubellum	Moss
	Sphagnum russowii	Moss
	Sphagnum squarrosum	Moss
	Sphagnum subsecundum	Moss
	Sphagnum teres	Moss
	Sphagnum warnstorfii	Moss
Splachnaceae	*Aplodon wormskjoldii*	Moss
	Splachnum ampullaceum	Moss
	Splachnum luteum	Moss
	Splachnum rubrum	Moss
	Splachnum sphaericum	Moss
	Splachnum vasculosum	Moss
	Tayloria froelichiana	Moss
	Tayloria lingulata	Moss
	Tayloria serrata	Moss
	Tetraplodon angustatus	Moss
	Tetraplodon mnioides	Moss
	Tetraplodon paradoxus	Moss
	Tetraplodon urceolatus	Moss
	Voitia nivalis	Moss
Tetraphidaceae	*Tetraphis pellucida*	Moss
	Tetrodontium repandum	Moss
Thuidiaceae	*Thuidium recognitum*	Moss
	Abietinella abietina	Moss
Timmiaceae	*Timmia megapolitana var. megapolitana*	Moss
	Timmia norvegica ssp. norvegica	Moss
	Timmia norvegica	Moss
	Timmia austriaca	Moss
	Timmia megapolitana	Moss

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
Acarosporaceae	*Myriospora smaragdula*	Lichen
	Sporastatia polyspora	Lichen
	Sporastatia testudinea	Lichen
Agyriaceae	*Xylographa parallela*	Lichen
	Xylographa vitiligo	Lichen
Alectoriaceae	*Alectoria ochroleuca*	Lichen
	Gowardia nigricans	Lichen
Anamylopsoraceae	*Anamylopsora pulcherrima*	Lichen
Arthrorhaphidaceae	*Arthrorhaphis alpina*	Lichen
Bacidiaceae	*Bacidia bagliettoana*	Lichen
	Calvitimela armeniaca	Lichen
	Cliostomum griffithii	Lichen
	Japewia tornoënsis	Lichen
	Tephromela atra	Lichen
Baeomycetaceae	*Baeomyces placophyllus*	Lichen
	Baeomyces rufus	Lichen
	Dibaeis baeomyces	Lichen
Caliciaceae	*Calicium viride*	Lichen
Candelariaceae	*Candelariella vitellina*	Lichen
Catillariaceae	*Toninia sedifolia*	Lichen
	Toninia squalida	Lichen
Cladoniaceae	*Cladonia acuminata*	Lichen
	Cladonia alaskana	Lichen
	Cladonia albonigra	Lichen
	Cladonia amaurocraea	Lichen
	Cladonia arbuscula	Lichen
	Cladonia arbuscula subsp. beringiana	Lichen
	Cladonia bacilliformis	Lichen
	Cladonia bellidiflora	Lichen
	Cladonia borealis	Lichen
	Cladonia botrytes	Lichen
	Cladonia cariosa	Lichen
	Cladonia carneola	Lichen
	Cladonia cenotea	Lichen
	Cladonia chlorophaea	Lichen
	Cladonia ciliata	Lichen
	Cladonia coccifera	Lichen
	Cladonia coniocraea	Lichen
	Cladonia cornuta subsp. cornuta	Lichen
	Cladonia cornuta	Lichen
	Cladonia cornuta subsp. groenlandica	Lichen
	Cladonia crispata var. crispata	Lichen
	Cladonia crispata var. cetrariiformis	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Cladonia cristatella	Lichen
	Cladonia cyanipes	Lichen
	Cladonia decorticata	Lichen
	Cladonia deformis	Lichen
	Cladonia digitata	Lichen
	Cladonia ecmocyna	Lichen
	Cladonia ecmocyna subsp. ecmocyna	Lichen
	Cladonia ecmocyna subsp. intermedia	Lichen
	Cladonia fimbriata	Lichen
	Cladonia furcata	Lichen
	Cladonia gracilis subsp. turbinata	Lichen
	Cladonia gracilis subsp. gracilis	Lichen
	Cladonia gracilis	Lichen
	Cladonia gracilis subsp. elongata	Lichen
	Cladonia gracilis subsp. vulnerata	Lichen
	Cladonia grayi	Lichen
	Cladonia macilenta	Lichen
	Cladonia macilenta var. bacillaris	Lichen
	Cladonia macroceras	Lichen
	Cladonia macrophylla	Lichen
	Cladonia macrophyllodes	Lichen
	Cladonia merochlorophaea	Lichen
	Cladonia mitis	Lichen
	Cladonia multiformis	Lichen
	Cladonia ochrochlora	Lichen
	Cladonia phyllophora	Lichen
	Cladonia pleurota	Lichen
	Cladonia pocillum	Lichen
	Cladonia pyxidata	Lichen
	Cladonia rangiferina	Lichen
	Cladonia scabriuscula	Lichen
	Cladonia singularis	Lichen
	Cladonia squamosa	Lichen
	Cladonia squamosa var. subsquamosa	Lichen
	Cladonia stellaris	Lichen
	Cladonia straminea	Lichen
	Cladonia stygia	Lichen
	Cladonia subfurcata	Lichen
	Cladonia subulata	Lichen
	Cladonia sulphurina	Lichen
	Cladonia symphycarpa	Lichen
	Cladonia trassii	Lichen
	Cladonia umbricola	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Cladonia uncialis	Lichen
	Cladonia verruculosa	Lichen
	Cladonia verticillata	Lichen
	Cladonia wainioi	Lichen
	Pycnothelia papillaria	Lichen
Coccocarpiaceae	*Spilonema revertens*	Lichen
Coenogoniaceae	*Coenogonium pineti*	Lichen
Collemataceae	*Blennothallia crispa*	Lichen
	Collema curtisporum	Lichen
	Collema flaccidum	Lichen
	Collema furfuraceum	Lichen
	Collema leptaleum	Lichen
	Collema subflaccidum	Lichen
	Collema tenax	Lichen
	Enchylium polycarpon	Lichen
	Lathagrium cristatum	Lichen
	Lathagrium fuscovirens	Lichen
	Lathagrium undulatum	Lichen
	Lathagrium undulatum var. granulosum	Lichen
	Leciophysma finmarkicum	Lichen
	Leptogium burnetiae	Lichen
	Leptogium hirsutum	Lichen
	Leptogium saturninum	Lichen
	Rostania ceranisca	Lichen
	Rostania occultata	Lichen
	Scytinium gelatinosum	Lichen
	Scytinium imbricatum	Lichen
	Scytinium lichenoides	Lichen
	Scytinium tenuissimum	Lichen
Coniocybaceae	*Chaenotheca brachypoda*	Lichen
	Chaenotheca chrysocephala	Lichen
	Chaenotheca furfuracea	Lichen
	Chaenotheca laevigata	Lichen
	Chaenotheca stemonea	Lichen
	Chaenotheca trichialis	Lichen
Erysiphaceae	*Illosporium carneum*	Lichen
Fuscideaceae	*Mycobilimbia berengeriana*	Lichen
	Orphniospora moriopsis	Lichen
	Ropalospora lugubris	Lichen
Gomphillaceae	*Sagiolechia rhexoblephara*	Lichen
Gyalectaceae	*Gyalecta foveolaris*	Lichen
Hymeneliaceae	*Aspicilia aliena*	Lichen
	Aspicilia cinerea	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Aspicilia disserpens	Lichen
	Aspicilia supertegens	Lichen
	Aspilidea myrinii	Lichen
	Hymenelia epulotica	Lichen
	Megaspora verrucosa	Lichen
	Tremolecia atrata	Lichen
	Ionaspis lacustris	Lichen
	Ionaspis odora	Lichen
Icmadophilaceae	*Icmadophila ericetorum*	Lichen
	Thamnolia subuliformis	Lichen
	Thamnolia vermicularis	Lichen
Lecanoraceae	*Bryonora castanea*	Lichen
	Lecanora aleutica	Lichen
	Lecanora chlarotera	Lichen
	Lecanora epibryon	Lichen
	Lecanora impudens	Lichen
	Lecanora muralis	Lichen
	Lecanora polytropa	Lichen
	Lecidella euphorea	Lichen
	Lecidella stigmatea	Lichen
	Rhizoplaca chrysoleuca	Lichen
	Rhizoplaca melanophthalma	Lichen
	Ramboldia cinnabarina	Lichen
Lecideaceae	*Bryobilimbia diapensiae*	Lichen
	Lecidea lapicida	Lichen
Lichinaceae	*Ephebe lanata*	Lichen
	Euopsis pulvinata	Lichen
	Lempholemma polyanthes	Lichen
	Lichinodium canadense	Lichen
	Lichinodium sirosiphoideum	Lichen
Lobariaceae	*Anomalobaria anomala*	Lichen
	Dendriscocaulon umhausense	Lichen
	Dendriscosticta wrightii	Lichen
	Lobaria hallii	Lichen
	Lobaria linita	Lichen
	Lobaria pseudopulmonaria	Lichen
	Lobaria pulmonaria	Lichen
	Lobaria scrobiculata	Lichen
	Pseudocyphellaria crocata	Lichen
	Pseudocyphellaria perpetua	Lichen
	Sticta arctica	Lichen
	Sticta limbata	Lichen
Micareaceae	*Micarea misella*	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
Mycoblastaceae	*Mycoblastus affinis*	Lichen
	Mycoblastus sanguinarius	Lichen
Mycocaliciaceae	*Phaeocalicium populneum*	Lichen
Nephromataceae	*Nephroma arcticum*	Lichen
	Nephroma bellum	Lichen
	Nephroma expallidum	Lichen
	Nephroma helveticum subsp. helveticum	Lichen
	Nephroma helveticum	Lichen
	Nephroma helveticum subsp. sipeanum	Lichen
	Nephroma isidiosum	Lichen
	Nephroma laevigatum	Lichen
	Nephroma parile	Lichen
	Nephroma resupinatum	Lichen
Ophioparmaceae	*Ophioparma lapponica*	Lichen
	Ophioparma ventosa	Lichen
Pannariaceae	*Erioderma pedicellatum*	Lichen
	Fuscopannaria ahlneri	Lichen
	Fuscopannaria praetermissa	Lichen
	Fuscopannaria ramulina	Lichen
	Fuscopannaria viridescens	Lichen
	Pannaria conoplea	Lichen
	Parmeliella triptophylla	Lichen
	Protopannaria pezizoides	Lichen
	Psoroma hypnorum	Lichen
	Santessoniella arctophila var. arctophila	Lichen
Parmeliaceae	*Allantoparmelia almquistii*	Lichen
	Allantoparmelia alpicola	Lichen
	Arctoparmelia centrifuga	Lichen
	Arctoparmelia incurva	Lichen
	Arctoparmelia separata	Lichen
	Asahinea chrysantha	Lichen
	Asahinea scholanderi	Lichen
	Brodoa oroarctica	Lichen
	Bryocaulon divergens	Lichen
	Bryoria capillaris	Lichen
	Bryoria fremontii	Lichen
	Bryoria furcellata	Lichen
	Bryoria fuscescens	Lichen
	Bryoria glabra	Lichen
	Bryoria implexa	Lichen
	Bryoria lanestris	Lichen
	Bryoria nadvornikiana	Lichen
	Bryoria nitidula	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Bryoria pseudofuscescens	Lichen
	Bryoria simplicior	Lichen
	Bryoria trichodes subsp. americana	Lichen
	Bryoria trichodes	Lichen
	Cavernularia hultenii	Lichen
	Cetraria aculeata	Lichen
	Cetraria ericetorum subsp. ericetorum	Lichen
	Cetraria ericetorum	Lichen
	Cetraria ericetorum subsp. reticulata	Lichen
	Cetraria islandica subsp. islandica	Lichen
	Cetraria islandica	Lichen
	Cetraria islandica subsp. crispiformis	Lichen
	Cetraria kamczatica	Lichen
	Cetraria laevigata	Lichen
	Cetraria nigricans	Lichen
	Cetraria odontella	Lichen
	Cetrariella commixta	Lichen
	Cetrariella delisei	Lichen
	Dactylina arctica	Lichen
	Dactylina beringica	Lichen
	Dactylina ramulosa	Lichen
	Evernia divaricata	Lichen
	Evernia mesomorpha	Lichen
	Flavocetraria cucullata	Lichen
	Flavocetraria minuscula	Lichen
	Flavocetraria nivalis	Lichen
	Hypogymnia apinnata	Lichen
	Hypogymnia austerodes	Lichen
	Hypogymnia bitteri	Lichen
	Hypogymnia occidentalis	Lichen
	Hypogymnia physodes	Lichen
	Hypogymnia pulverata	Lichen
	Hypogymnia subobscura	Lichen
	Hypogymnia tubulosa	Lichen
	Hypogymnia vittata	Lichen
	Masonhalea richardsonii	Lichen
	Melanelia agnata	Lichen
	Melanelia hepatizon	Lichen
	Melanelia stygia	Lichen
	Melanelixia subaurifera	Lichen
	Melanohalea olivacea	Lichen
	Melanohalea exasperatula	Lichen
	Melanohalea infumata	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Melanohalea septentrionalis	Lichen
	Melanohalea subolivacea	Lichen
	Melanohalea trabeculata	Lichen
	Montanelia disjuncta	Lichen
	Montanelia panniformis	Lichen
	Montanelia sorediata	Lichen
	Montanelia tominii	Lichen
	Parmelia fraudans	Lichen
	Parmelia hygrophila	Lichen
	Parmelia omphalodes subsp. omphalodes	Lichen
	Parmelia omphalodes	Lichen
	Parmelia saxatilis	Lichen
	Parmelia skultii	Lichen
	Parmelia squarrosa	Lichen
	Parmelia sulcata	Lichen
	Parmelina yalungana	Lichen
	Parmeliopsis ambigua	Lichen
	Parmeliopsis hyperopta	Lichen
	Platismatia glauca	Lichen
	Protoparmelia badia	Lichen
	Pseudephebe minuscula	Lichen
	Pseudephebe pubescens	Lichen
	Tuckermannopsis americana	Lichen
	Tuckermannopsis chlorophylla	Lichen
	Tuckermannopsis sepincola	Lichen
	Usnea hirta	Lichen
	Usnea longissima	Lichen
	Usnea substerilis	Lichen
	Vulpicida pinastri	Lichen
	Vulpicida tilesii	Lichen
	Xanthoparmelia coloradoënsis	Lichen
	Xanthoparmelia stenophylla	Lichen
	Usnea lapponica	Lichen
	Imshaugia aleurites	Lichen
Peltigeraceae	*Peltigera aphthosa*	Lichen
	Peltigera canina	Lichen
	Peltigera collina	Lichen
	Peltigera didactyla	Lichen
	Peltigera elisabethae	Lichen
	Peltigera extenuata	Lichen
	Peltigera gowardii	Lichen
	Peltigera horizontalis	Lichen
	Peltigera kristinssonii	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Peltigera lepidophora	Lichen
	Peltigera leucophlebia	Lichen
	Peltigera malacea	Lichen
	Peltigera membranacea	Lichen
	Peltigera neckeri	Lichen
	Peltigera neopolydactyla	Lichen
	Peltigera occidentalis	Lichen
	Peltigera polydactylon	Lichen
	Peltigera ponojensis	Lichen
	Peltigera praetextata	Lichen
	Peltigera retifoveata	Lichen
	Peltigera rufescens	Lichen
	Peltigera scabrosa	Lichen
	Peltigera venosa	Lichen
	Solorina bispora	Lichen
	Solorina crocea	Lichen
	Solorina octospora	Lichen
	Solorina saccata	Lichen
	Solorina spongiosa	Lichen
	Massalongia carnosa	Lichen
Pertusariaceae	*Ochrolechia upsaliensis*	Lichen
	Pertusaria carneopallida	Lichen
	Pertusaria dactylina	Lichen
	Pertusaria oculata	Lichen
	Pertusaria panyrga	Lichen
	Pertusaria saximontana	Lichen
	Pertusaria subdactylina	Lichen
	Variolaria ophthalmiza	Lichen
	Ochrolechia frigida	Lichen
Physciaceae	*Amandinea punctata*	Lichen
	Anaptychia bryorum	Lichen
	Buellia disciformis	Lichen
	Buellia erubescens	Lichen
	Dimelaena oreina	Lichen
	Heterodermia speciosa	Lichen
	Phaeophyscia constipata	Lichen
	Phaeophyscia endococcina	Lichen
	Phaeophyscia orbicularis	Lichen
	Phaeophyscia sciastra	Lichen
	Phaeorrhiza nimbosa	Lichen
	Phaeorrhiza sareptana	Lichen
	Physcia alnophila	Lichen
	Physcia caesia	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Physcia dubia	Lichen
	Physcia phaea	Lichen
	Physconia detersa	Lichen
	Physconia muscigena	Lichen
	Rinodina archaea	Lichen
	Rinodina mniaraea	Lichen
	Rinodina turfacea	Lichen
	Heterodermia japonica	Lichen
Placynthiaceae	*Placynthium nigrum*	Lichen
	Placynthium stenophyllum var. isidiatum	Lichen
	Polychidium muscicola	Lichen
	Vestergrenopsis isidiata	Lichen
Porpidiaceae	*Amygdalaria elegantior*	Lichen
	Amygdalaria panaeola	Lichen
	Amygdalaria pelobotryon	Lichen
	Bellemerea alpina	Lichen
	Bilimbia lobulata	Lichen
	Mycobilimbia carneoalbida	Lichen
	Mycobilimbia pilularis	Lichen
	Mycobilimbia tetramera	Lichen
	Porpidia albocaerulescens	Lichen
	Porpidia flavocaerulescens	Lichen
	Porpidia macrocarpa	Lichen
Protothelenellaceae	*Protothelenella sphinctrinoides*	Lichen
Psoraceae	*Lecidoma demissum*	Lichen
	Protoblastenia rupestris	Lichen
	Psora decipiens	Lichen
	Psora himalayana	Lichen
	Psora rubiformis	Lichen
Ramalinaceae	*Ramalina dilacerata*	Lichen
	Ramalina obtusata	Lichen
	Ramalina roesleri	Lichen
	Ramalina thrausta	Lichen
	Ramalina farinacea	Lichen
Rhizocarpaceae	*Epilichen scabrosus*	Lichen
	Rhizocarpon alpicola	Lichen
	Rhizocarpon copelandii	Lichen
	Rhizocarpon eupetraeum	Lichen
	Rhizocarpon geographicum	Lichen
	Rhizocarpon intermediellum	Lichen
	Rhizocarpon rittokense	Lichen
	Rhizocarpon superficiale	Lichen
	Rhizocarpon viridiatrum	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
	Rhizocarpon grande	Lichen
	Rhizocarpon chioneum	Lichen
Schaereriaceae	*Schaereria brunnea*	Lichen
	Schaereria cinereorufa	Lichen
Sphaerophoraceae	*Sphaerophorus fragilis*	Lichen
	Sphaerophorus globosus	Lichen
Stereocaulaceae	*Pilophorus robustus*	Lichen
	Stereocaulon alpinum	Lichen
	Stereocaulon arenarium	Lichen
	Stereocaulon botryosum	Lichen
	Stereocaulon condensatum	Lichen
	Stereocaulon depressum	Lichen
	Stereocaulon glareosum	Lichen
	Stereocaulon grande	Lichen
	Stereocaulon intermedium	Lichen
	Stereocaulon paschale	Lichen
	Stereocaulon rivulorum	Lichen
	Stereocaulon sasakii	Lichen
	Stereocaulon sasakii var. tomentosoides	Lichen
	Stereocaulon spathuliferum	Lichen
	Stereocaulon sterile	Lichen
	Stereocaulon subcoralloides	Lichen
	Stereocaulon tomentosum	Lichen
	Stereocaulon vesuvianum	Lichen
Stictidaceae	*Thelopsis melathelia*	Lichen
Teloschistaceae	*Amundsenia approximata*	Lichen
	Athallia holocarpa	Lichen
	Bryoplaca jungermanniae	Lichen
	Caloplaca cerina	Lichen
	Caloplaca insularis	Lichen
	Gyalolechia xanthostigmoidea	Lichen
	Polycauliona candelaria	Lichen
	Rusavskia elegans	Lichen
	Rusavskia sorediata	Lichen
	Blastenia ferruginea	Lichen
	Polycauliona polycarpa	Lichen
Thelotremataceae	*Diploschistes scruposus*	Lichen
Thrombiaceae	*Thrombium epigaeum*	Lichen
Trapeliaceae	*Placopsis gelida*	Lichen
	Placynthiella icmalea	Lichen
	Placynthiella uliginosa	Lichen
	Trapeliopsis granulosa	Lichen
	Trapeliopsis viridescens	Lichen

Denali Biosphere Region Species List - Flora, *continued*

Family	Scientific Name	Life Form
Tricholomataceae	*Lichenomphalia hudsoniana*	Lichen
	Lichenomphalia umbellifera	Lichen
Umbilicariaceae	*Lasallia caroliniana*	Lichen
	Lasallia pensylvanica	Lichen
	Umbilicaria americana	Lichen
	Umbilicaria angulata	Lichen
	Umbilicaria arctica	Lichen
	Umbilicaria cinereorufescens	Lichen
	Umbilicaria cylindrica	Lichen
	Umbilicaria deusta	Lichen
	Umbilicaria hyperborea var. hyperborea	Lichen
	Umbilicaria hyperborea	Lichen
	Umbilicaria hyperborea var. radicicula	Lichen
	Umbilicaria lyngei	Lichen
	Umbilicaria proboscidea	Lichen
	Umbilicaria scholanderi	Lichen
	Umbilicaria vellea	Lichen
	Umbilicaria virginis	Lichen
	Umbilicaria rigida	Lichen
	Umbilicaria torrefacta	Lichen
Verrucariaceae	*Catapyrenium cinereum*	Lichen
	Dermatocarpon miniatum	Lichen
	Dermatocarpon rivulorum	Lichen
	Placidium lachneum	Lichen
	Polyblastia cucurbitula	Lichen
	Polyblastia theleodes	Lichen
	Staurothele clopimoides	Lichen
	Staurothele fissa	Lichen
	Verrucaria muralis	Lichen

Appendix F. Stakeholder List

Denali Biosphere Reserve Stakeholders List

- Association for Responsible Development
- Alaska Bird Observatory
- Alaska Conservation Foundation
- Alaska Geographic Field Institute
- Alaska Department of Environmental Conservation
- Alaska Department of Fish and Game
- Alaska Parks and Recreation
- Alaska Department of Natural Resources
- Alaska State Historic Preservation Office
- Audubon Society
- Biodiversity Conservation Alliance
- Bureau of Land Management
- Bureau of Reclamation
- Denali Borough
- Defenders of Wildlife
- Tri-Valley School
- Denali Citizens Council
- Denali Education Center
- Environmental Protection Agency
- Federal Aviation Authority
- Mat-Su Borough
- Northern Environmental Center
- National Parks and Conservation Association
- National Wild and Scenic Rivers System
- Partnership for the National Trails System
- State of Alaska
- U.S. Army Corps of Engineers
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- U.S. Department of Agriculture Natural Resource Conservation Service

Appendix G. Partner List

Partners of Denali Biosphere Region

- Nikolai Edzeno Council
- Telida Council
- Ingalik Council
- Tanana Council
- Association for Responsible Development
- Alaska Bird Observatory
- Alaska Conservation Foundation
- Alaska Geographic Field Institute
- Alaska Department of Environmental Conservation
- Alaska Department of Fish and Game
- Alaska Parks and Recreation
- Alaska Department of Natural Resources
- Alaska Wildlife Heritage Foundation
- Alaska House
- Alaska Senate
- Alaska Open Lands
- Alaska State Historic Preservation Office
- Audubon Society
- Biodiversity Conservation Alliance
- Bureau of Land Management
- Bureau of Reclamation
- Unincorporated City of Healy
- Unicorporated City of Cantwell
- City of Anderson
- Denali Borough
- Defenders of Wildlife
- Tri-Valley Library
- Tri-Valley School
- Denali Citizens Council
- Denali Education Center
- Environmental Protection Agency
- Federal Aviation Authority
- Healy Chamber of Commerce
- Great Old Broads for Wilderness
- International Mountain Biking Association
- Mat-Su Borough
- National Federation of the Blind
- Northern Environmental Center
- National Parks and Conservation Association
- National Wild and Scenic Rivers System
- Office of Representative Don Young
- Office of Senator Lisa Murkowski
- Office of Senator Dan Sullivan
- Partnership for the National Trails System
- State of Alaska
- Sierra Club Alaska Chapter
- Koyokuk Council
- The National Organization on Disability
- The Wilderness Society
- University of Alaska Fairbanks Archives
- University of Alaska Anchorage Archives
- University of Alaska Fairbanks
- University of Alaska Anchorage
- U.S. Army Corps of Engineers
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- U.S. Department of Agriculture Natural Resource Conservation Service

Appendix H. Agreement with Alaska Department of Fish and Game

MASTER MEMORANDUM OF UNDERSTANDING
BETWEEN
THE ALASKA DEPARTMENT OF FISH AND GAME
JUNEAU, ALASKA
AND
THE U.S. NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
ANCHORAGE, ALASKA

This Master Memorandum of Understanding between the State of Alaska, Department of Fish and Game, hereinafter referred to as the Department, and the U.S. Department of the Interior, National Park Service, hereinafter referred to as the Service, reflects the general policy guidelines within which the two agencies agree to operate.

WHEREAS, the Department, under the Constitution, laws, and regulations of the State of Alaska, is responsible for the management, protection, maintenance, enhancement, rehabilitation, and extension of the fish and wildlife resources of the State on the sustained yield principle, subject to preferences among beneficial uses; and

WHEREAS, the Service, by authority of the Constitution, laws of Congress, executive orders, and regulations of the U.S. Department of the Interior is responsible for the management of Service lands in Alaska and the conservation of resources on these lands, including conservation of healthy populations of fish and wildlife within National Preserves and natural and healthy populations within National Parks and Monuments; and

WHEREAS, the Department and the Service share a mutual concern for fish and wildlife resources and their habitats and desire to develop and maintain a cooperative relationship which will be in the best interests of both parties,

the fish and wildlife resources and their habitats, and produce the greatest public benefit; and

WHEREAS, the Alaska National Interest Lands Conservation Act (ANILCA) and subsequent implementing Federal regulations recognize that the resources and uses of Service lands in Alaska are substantially different than those of similar lands in other states and mandate continued subsistence uses in designated National Parks plus sport hunting and fishing, subsistence, and trapping uses in National Preserves under applicable State and Federal laws and regulations; and

WHEREAS, the Department and the Service recognize the increasing need to coordinate resource planning and policy development;

NOW, THEREFORE, the parties hereto do hereby agree as follows:

THE DEPARTMENT OF FISH AND GAME AGREES:

1. To recognize the Service's responsibility to conserve fish and wildlife and their habitat and regulate human use on Service lands in Alaska, in accordance with the National Park Service Organic Act, ANILCA, and other applicable laws.

2. To manage fish and resident wildlife populations in their natural species diversity on Service lands, recognizing that nonconsumptive use and appreciation by the visiting public is a primary consideration.

3. To consult with the Regional Director or his representative in a timely manner and comply with applicable Federal laws and regulations before embarking on management activities on Service lands.

4. To act as the primary agency responsible for management of subsistence uses of fish and wildlife on State and Service lands, pursuant to applicable State and Federal laws.

5. To recognize that National Park areas were established, in part, to "assure continuation of the natural process of biological succession" and "to maintain the environmental integrity of the natural features found in them."

THE NATIONAL PARK SERVICE AGREES:

1. To recognize the Department as the agency with the primary responsibility to manage fish and resident wildlife within the State of Alaska.

2. To recognize the right of the Department to enter onto Service lands after timely notification to conduct routine management activities which do not involve construction, disturbance to the land, or alterations of ecosystems.

3. To manage the fish and wildlife habitat on Service lands so as to ensure conservation of fish and wildlife populations and their habitats in their natural diversity.

4. To cooperate with the Department in planning for management activities on Service lands which require permits, environmental assessments, compatibility assessments, or similar regulatory documents by responding to the Department in a timely manner.

5. To consider carefully the impact on the State of Alaska of proposed treaties or international agreements relating to fish and wildlife resources which could diminish the jurisdictional authority of the State, and to consult freely with the State when such treaties or agreements have a significant impact on the State.

6. To review Service policies in consultation with the Department to determine if modified or special policies are needed for Alaska.

7. To adopt Park and Preserve management plans whose provisions are in substantial agreement with the Department's fish and wildlife management plans, unless such plans are determined formally to be incompatible with the purposes for which the respective Parks and Preserves were established.

8. To utilize the State's regulatory process to the maximum extent allowed by Federal law in developing new or modifying existing Federal regulations or proposing changes in existing State regulations governing or affecting the taking of fish and wildlife on Service lands in Alaska.

9. To recognize the Department as the primary agency responsible for policy development and management direction relating to subsistence uses of fish and wildlife resources on State and Service lands, pursuant to applicable State and Federal laws.

10. To consult and cooperate with the Department in the design and conduct of Service research or management studies pertaining to fish and wildlife.

11. To consult with the Department prior to entering into any cooperative land management agreements.

12. To allow under special use permit the erection and maintenance of facilities or structures needed to further fish and wildlife management activities of the Department on Service lands, provided their intended use is not in conflict with the purposes for which affected Parks or Preserves were established.

HDF&G/NPS-5

THE DEPARTMENT OF FISH AND GAME AND THE NATIONAL PARK SERVICE MUTUALLY AGREE:

1. To coordinate planning for management of fish and wildlife resources on Service lands so that conflicts arising from differing legal mandates, objectives, and policies either do not arise or are minimized.

2. To consult with each other when developing policy, legislation, and regulations which affect the attainment of wildlife resource management goals and objectives of the other agency.

3. To provide to each other upon request fish and wildlife data, information, and recommendations for consideration in the formulation of policies, plans, and management programs regarding fish and wildlife resources on Service lands.

4. To recognize that the taking of fish and wildlife by hunting, trapping, or fishing on certain Service lands in Alaska is authorized in accordance with applicable State and Federal law unless State regulations are found to be incompatible with documented Park or Preserve goals, objectives or management plans.

5. To recognize for maintenance, rehabilitation, and enhancement purposes, that under extraordinary circumstances the manipulation of habitat or animal populations may be an important tool of fish and wildlife management to be used cooperatively on Service lands and waters in Alaska by the Service or the Department when judged by the Service, on a case by case basis, to be consistent with applicable law and Park Service policy.

6. That implementation by the Secretary of the Interior of subsistence program recommendations developed by Park and Park Monument Subsistence Resource

ADF&G/NPS – 6

Commissions pursuant to ANILCA Section 808(b) will take into account existing State regulations and will use the State's regulatory process as the primary means of developing Park subsistence use regulations.

7. To neither make nor sanction any introduction or transplant of any fish or wildlife species on Service lands without first consulting with the other party and complying with applicable Federal and State laws and regulations.

8. To cooperate in the development of fire management plans which may include establishment of priorities for the control of wildfires and use of prescribed fires.

9. To consult on studies for additional wilderness designations and in development of regulations for management of wilderness areas on Service lands.

10. To resolve, at field office levels, all disagreements pertaining to the cooperative work of the two agencies which arise in the field and to refer all matters of disagreement that cannot be resolved at equivalent field levels to the Regional Director and to the Commissioner for resolution before either agency expresses its position in public.

11. To meet annually to discuss matters relating to the management of fish and wildlife resources on, or affected by, Service lands.

12. To develop such supplemental memoranda of understanding between the Commissioner and the Regional Director as may be required to implement the policies contained herein.

13. That the Master Memorandum of Understanding is subject to the availability of appropriated State and Federal funds.

14. That this Master Memorandum of Understanding establishes procedural guidelines by which the parties shall cooperate, but does not create legally enforceable obligations or rights.

15. That this Master Memorandum of Understanding shall become effective when signed by the Commissioner of the Alaska Department of Fish and Game and the Alaska Regional Director of the National Park Service and shall continue in force until terminated by either party by providing notice in writing 120 days in advance of the intended date of termination.

16. That amendments to this Master Memorandum of Understanding may be proposed by either party and shall become effective upon approval by both parties.

STATE OF ALASKA

Department of Fish and Game

By Ronald O. Skoog
Ronald O. Skoog
Commissioner

Date 14 October 1982

U.S. DEPARTMENT OF THE INTERIOR

National Park Service

By John E. Cook
John E. Cook
Regional Director, Alaska

Date October 5, 1982

7

Appendix I. Agreement with the Bureau of Land Management and U.S. Fish and Wildlife Service

MEMORANDUM OF UNDERSTANDING

between
The Bureau of Land Management, Alaska
The National Park Service, Alaska Region
and
The U.S. Fish and Wildlife Service, Region 7

I. Purpose

The purpose of this Memorandum of Understanding is to clarify the procedures to be used in determining which agency will administer certain ANCSA 17(b) easements, the process for administering those easements, and for the termination of easements.

II. Background

Section 17(b) of the Alaska Native Claims Settlement Act (ANCSA), 43 U.S.C. 1616(b), authorizes the reservation of public easements on lands conveyed to Native regional and village corporations. Department Manual 601 DM 4 (September 11, 1984) establishes procedures for the administration of easements under the jurisdiction of the Department of the Interior. It provides that an easement reserved pursuant to Section 17(b) of ANCSA shall be administered by the Department of the Interior agency whose land is accessed by the easement.

To date approximately 2,050 easements have been reserved under the authority of ANCSA. Present estimates are that the Bureau of Land Management (BLM) will administer forty-eight percent (48%) of the easements, twenty-two percent (22%) will be administered by the U.S. Fish and Wildlife Service (F&WS), and three percent will be administered by the National Park Service (NPS). The remaining twenty-seven percent (27%) are, or may be, administered by non-Interior agencies such as the U.S. Forest Service, the U.S. Coast Guard, Federal Aviation Administration, U.S. Air Force, U.S. Navy, the State of Alaska, a borough, or municipal government.

III. Authority

- Alaska Native Claims Settlement Act (ANCSA) - 43 U.S.C. 1616(b).
- Alaska National Interest Lands Conservation Act (ANILCA) - 16 U.S.C. 3101
- Federal Land Policy [and] Management Act of 1976 (FLPMA) - 43 U.S.C. 1701, et seq.
- Fish and Wildlife Act of 1956 - 16 U.S.C. 742a - 742j, as amended.
- National Wildlife Refuge System Administration Act of 1966 - 16 U.S.C. 668dd-668ee, as amended.
- National Park Service Organic Act of 1916 - 16 USC 1, as amended.

IV. Definitions

The following definitions apply to this document:

Conformance: The process by which a reserved easement is conformed to the legal criteria set out at 43 CFR 2650.4-7, if necessary and appropriate (Generally these are conveyances made prior to the promulgation of the current regulations of 1976 [1978] and in such cases there are often specific easement conformance agreements with the affected ANCSA corporation).

Conservation System Unit: A Conservation System Unit (CSU) is any unit in Alaska of the National Park System, National Wildlife Refuge System, National Wild and Scenic Rivers System, National Trails System, National Wilderness Preservation System, or a National Forest Monument, including existing units, units established, designated, or expanded by or under the provisions of ANILCA, additions to such units, and any such units established, designated, or expanded hereafter.

Determination of Administration: The procedure used to ascertain which agency has responsibility for administration of an easement reserved under Section 17(b) of ANCSA.

Easement: A non-possessory interest in land, reserved under Section 17(b) of ANCSA, which allows for public use of specifically identified sites or routes for public access across lands conveyed to Native regional and village corporations.

Transfer of Administration: The procedure by which an agency having administrative responsibility for a 17(b) easement may transfer its responsibility to another Federal agency, the State of Alaska, a borough, or municipal government.

Termination: A release to the servient landowner of the easement interest held by the United States.

V. Determination of Administration:

A. Easements reserved within the exterior boundaries of a CSU shall be administered by the agency managing the CSU.

B. Easements that access a CSU shall be administered by the agency managing the CSU.

C. Easements accessing private lands and not within the boundaries of a CSU or accessing a CSU shall be administered by the BLM, until administration is assumed by another agency or the easement is terminated.

D. Easements accessing State lands and not within the boundaries of a CSU are eligible for administration by the State.

E. If an easement accesses lands managed by more than one agency, the agency having the largest land area accessed by the easement shall be responsible for administration of the entire easement.

F. BLM shall conform easements in accordance with the current regulations and applicable easement agreements, prior to the determination of administration of the easement.

G. The BLM shall recommend the appropriate administering agency (except for easements within a CSU), and shall notify that agency in writing of the easement determination. Upon

concurrence by the affected agency, the Bureau will effect transfer of administration of the easement, by noting the public land record and forwarding a copy of the easement case file to the affected agency. Agency notification shall include those items specified in Departmental Manual 601 DM 4.3A.

VI. Administration

If an easement administered by an agency accesses lands managed by another agency or agencies, the administering agency shall consult the affected agency or agencies at least 30 days prior to taking any action that significantly affects use of the easement except in the case of emergency actions necessary for protection of life or property. This requirement to consult shall not be construed as requiring consent.

VII. Transfer of Administration

A. An agency with responsibility for administration of an easement may transfer administration of that easement to another Federal agency, the State of Alaska, a borough, or municipal government only if such a transfer is in the best interest of the United States, is otherwise authorized by law and the public will be guaranteed reasonably necessary public access. Transfer of administration shall be in accordance with Departmental Manual 601 DM 4.4A and B.

B. If an agency proposes to transfer administration of all or part of an easement, that agency will effect the transfer, then notify BLM in writing so that the public land record (easement file) can be noted. Any available updated plats or maps should be included by the transferring agency as part of the notification to BLM.

C. In cases where administration of an easement is transferred to the State, borough, or municipality, the easement holder remains the United States. The Federal agency transferring administration remains responsible for assuring the easement is managed in accordance with existing regulations and the Departmental Manual 601.

VIII. Termination of Administration

A. In accordance with Departmental Manual 601 D.M.4.4C and the Code of Federal Regulations, 43 C.F.R. 2650.4-7(a)(13), if an agency determines that an easement under its administration is no longer necessary for public use or governmental function, the Regional Director of the agency shall advise the BLM State Director in writing of its intention to terminate the easement. The notice shall be supported with documentation that:

1. the easement is no longer necessary for public access or governmental function; or

2. an alternative easement has been offered by the serviant landowner; or

3. termination is required by law.

B. The agency with administrative responsibility for the easement shall issue a notice of proposed action (termination of the easement) with a comment period of a minimum of 30 days, to the servient landowner and interested parties.

C. Upon completion of the comment period the administering agency shall make the decision on the disposition of the easement. A copy of the decision to terminate an easement will be

forwarded to the BLM, who will issue an appealable decision to terminate all or any portion of the easement.

D. If no appeal is filed, the BLM will process the request for termination of the easement, release all interest to the servient landowner, note the easement records, and close the case file.

E. If the decision is appealed, the responsible Department of the Interior agency will assist the Regional Solicitor's office in responding to the appeal. Appeals are decided by the Interior Board of Land Appeals (IBLA).

1. Upon receiving a decision from the IBLA, the BLM will notify the requesting agency in writing of the IBLA decision. If the decision is favorable, BLM will continue processing termination of the easement. If the decision is not favorable, BLM will document the easement file as to the IBLA decision and the easement will continue to be administered by the original agency.

F. No easement accessing isolated tracts of public land shall be terminated solely because of the absence of proof of public use. Public easements which have been reserved to guarantee international treaty obligations shall not be terminated unless the Secretary determines that the reasons for such easements no longer justify the reservation.

IX. General Provisions

A. Expenditure of Appropriated Funds

All performance in response to this MOU is subject to the availability of appropriated funds and existing statutory authority.

B. Termination of Agreement

This MOU may be terminated by any of the parties to the agreement upon giving ninety (90) days advance written notice to the other parties, providing that the notice allows sufficient time for an orderly completion of work in progress.

C. Reviews

This MOU will be reviewed every three (3) years to determine if changes should be made.

D. Changes

Renegotiation of any part of this MOU may be initiated at any time by any party to this MOU. Changes in the provisions of this MOU may be made only if all parties agree to the changes, the changes are put in writing, and added as an addendum to this MOU.

E. Limitations

Nothing in this agreement is to be construed as superceding or usurping existing laws, regulations, or agency responsibilities.

IN WITNESS THEREOF, the parties have executed this Memorandum of Understanding as of the last date written below.

State Director, Alaska

Bureau of Land Management

signed

Signature

12/6/1988

Date

Regional Director, Alaska

U.S. Fish and Wildlife Service

signed

Signature

12/12/1988

Date

Regional Director, Alaska

National Park Service

signed

Signature

12/7/1988

Date

Appendix J. Agreement with the USDA Forest Service

USDA, Forest Service	OMB 0596-0217 FS-1500-15

FS Agreement No. 13-MU-11132652-535
Cooperator Agreement No. _____

MEMORANDUM OF UNDERSTANDING
Between The
USDI, NATIONAL PARK SERVICE
And The
USDA, FOREST SERVICE
RESEARCH AND DEVELOPMENT

This MEMORANDUM OF UNDERSTANDING (MOU) is hereby made and entered into by and between the US Department of the Interior, National Park Service, hereinafter referred to as "NPS," and the USDA, Forest Service, Research and Development, hereinafter referred to as the "U.S. Forest Service."

Background: This MOU is a renewal of 06-SU-1 1132652-044.

Title: Framework for Cooperation in Inventorying and Monitoring Natural Resources

I. PURPOSE:

The purpose of this MOU is to establish a general framework for cooperation between the Forest Service and the NPS in inventorying and monitoring natural resources within the legal responsibilities of the respective agencies. Such cooperation, which brings together programmatic entities within the Forest Service research arm with individual entities within the NPS, is considered to be in the best interest of the United States Government in accordance with the following provisions.

II. STATEMENT OF MUTUAL BENEFIT AND INTERESTS:

It is recognized that the NPS, in managing lands under its jurisdiction (individual units of the National Park System, hereinafter called parks), has a need for information on the nature, distribution, status, condition, and trend of soil, water, animals, plants, plant and animal communities, and natural processes on such Federal lands, including their potential and limitations for long term preservation and tolerance to different human uses and activities.

It is recognized that the Forest Service has a need for information on the nature, distribution, status, condition, and trends in vegetation, soil, and water resources on Federal lands, including their potential and limitations for different values, uses, and activities.

The Forest Service discharges its inventory and monitoring obligations under the Forest and Rangelands Renewable Resources Research Act of 1978 (16 U.S.C. § 1642(e)), and is concerned with providing leadership for a national strategic inventory of forests across all land ownerships. This inventory, conducted by the Forest Service's Forest Inventory and Analysis Program, hereinafter called FIA, is carried out in cooperation with Federal and State agencies and private forest landowners.

The Forest Service FIA program inventory, mandated under the Forest and Rangelands Renewable Resources Research Act (16 U.S.C. § 1642(e)), is administered by the Forest Service, and on areas within park external boundaries will be conducted in cooperation with the NPS as outlined in this MOU.

Both the NPS and FIA have broad responsibilities that require detailed information and analysis to inform decisions on management of forest resources. It is beneficial to both agencies to collaborate in the collection of data, integration and synthesis of data collected independently and jointly by each agency, and to use this information to improve management of Federal lands. A goal of this MOU is to foster collaboration between FIA and the NPS that enables application of FIA data to support NPS activities and enhances the mission of FIA by integrating NPS data and information. The programs of both agencies will derive considerable benefits at both local and national levels from such cooperation.

In consideration of the above premises, the parties agree as follows:

III. THE NPS SHALL:

A. Provide long term conceptual commitment by the NPS that the NPS generally intends to allow U.S. Forest Service establishment and long term operation of FIA sites and to have park management of the area containing these sites be in keeping with the agreed guidelines of the FIA program and this MOU, consistent with provisions of the Park general management plan and other park management documents, and the laws and regulations applicable to the management of the National Park System.
B. Approve, as appropriate, Scientific Research and Collecting Permits, compliant with NPS requirements, which are necessary for Forest Service FIA inventory personnel to conduct mandated inventory responsibilities in accordance with park approved FIA work plans and the guidelines in Provision V.F. of this MOU.
C. Provide park logistic and other support in keeping with agreements identified in provisions of the Scientific Research and Collecting Permit.
D. Invite the Forest Service to participate in relevant NPS inventory and monitoring park, network, regional, and Service meetings.

IV. THE U.S. FOREST SERVICE SHALL:

A. Identify program intensification opportunities that FIA is prepared to authorize, identify those opportunities it is prepared to support, and develop agreement on who pays for or conducts any intensification opportunities that both parties agree to adopt.
B. Submit the Investigator's Annual Report electronically to the Park Superintendent according to approved NPS protocols.
C. Invite the NPS to attend the forest inventory work-planning conferences in each State containing lands administered by the NPS, and to participate in development of annual and long-range forest inventory plans where such lands are involved as appropriate.

V. IT IS MUTUALLY UNDERSTOOD AND AGREED BY AND BETWEEN THE PARTIES THAT:

A. FGDC COMPLIANCE. All inventories pursuant to this MOU will, at minimum, meet any standards established by the Federal Geographic Data Committee (FGDC) and its relevant subcommittees.

B. INVENTORY RESPONSIBILITY. The Forest Service FIA program inventory, mandated under the Forest and Rangelands Renewable Resources Research Act (16 U.S.C. § 1642(e)), is administered by the Forest Service, and on areas within park external boundaries will be conducted in cooperation with the NPS as outlined in this MOU.

C. WORK PLANS. A work plan will be developed for the parks in each NPS Region where FIA or other joint inventory and monitoring will be conducted. It will set forth the efforts of cooperating agencies for that area with respect to all activities in parks pertaining to Forest Service inventory and monitoring, and with respect to the limits established by this MOU. Interagency work plans for specific areas will be signed by the NPS Regional Director, or that official's designated representative, and the Forest Service Station Director, or those officials' designated representative. It is recognized that cooperation is a matter of working together to a common end, and is not dependent on, or in proportion to, the financial contribution of the cooperating agencies.

   The agencies, jointly or separately, as set forth in the interagency work plan(s) described above, will gather and analyze basic data required for soil, water, plant, animal, and habitat interpretation. Although all data will be gathered in ways that meet applicable FGDC Standards referenced in Section V.A., each agency will be responsible for the interpretive groupings of resource data as developed for use in its individual program.

D. FIA PLOT COORDINATES. The most accurate FIA plot location coordinates and all associated data for designated NPS lands will, when requested by the NPS, be made available to staff identified by the Park Superintendent upon compliance with guidance provided by FIA privacy policy and in compliance with the National Parks Omnibus Management Act of 1998. Public disclosure of any information regarding the exact location of FIA plots is prohibited, except as is required by law. Less accurate plot location information, available in on-line FIA databases, that does not

provide the ability for the general public to identify precise plot locations may be shared freely between agencies without restriction.

E. DISSEMINATION OF INFORMATION. Each of the cooperating agencies shall have full opportunity to cooperate appropriately in the planning, execution, dissemination, and publication of the results of all inventories conducted as a result of this MOU. It is recognized that the NPS and Forest Service individually will make in-house use of data, maps, and interpretations prior to a final report.

Parties to this MOU shall be free to use in official correspondence any of the results obtained in the inventories made under this MOU, and any work plans written hereunder, giving due credit to the other party. It is understood that the publishing of maps, reports, and data on inventories made by the cooperating agencies will be agreed upon in specific interagency work plans. However, each agency has the right to use or publish information as may be required, provided appropriate credit is given to the other agencies involved in making the inventories and provided there is no release of any specific information protected by law from release.

F. SPECIAL PROVISIONS.
The following are provided as minimum guidelines for conducting FIA inventories in units of the National Park System. Additional guidance and conditions may be established in coordination with individual Park Superintendents, but no such provisions may rescind these minimum guidelines unless by mutual written consent of both Principal Contacts listed in Provision H below.

Personnel/Equipment

- All working arrangements which might result in the temporary assignment of personnel, and/or the use of lands, buildings, and other facilities will be identified in the terms and conditions of park Scientific Research and Collecting Permits.
- Field data collection may be accomplished by Forest Service employees, State employees, and/or contractors. This may vary by regional FIA program. In all cases, data collectors will be operating as agents of the Forest Service FIA program and will be subject to Federal confidentiality requirements.
- Any equipment or supplies purchased for the conduct of this project shall remain the property of the purchasing program.

Field Access

- At least one month prior to commencement of field operations in a park, the FIA Principal Investigator named in the previously issued park permit will furnish the Park Research Coordinator with the following information:
  a. Name and contact information for FIA supervisor who will be overseeing conduct of field work.
  b. Approximate dates and locations of field work within park boundaries.
  c. Identification of number and type of pack animals or type of other supplemental means of transportation involved in inventory operations.
  d. Identification of planned overnight accommodations.

e. Upon the start of the field work, such specific information to be identified by the park as vehicle license plate numbers, radio frequencies used by and call names or numbers of all inventory crews, etc.

- This agreement, by itself, does not authorize any entry upon, or activities within, any lands not under the jurisdiction of the Park Manager, including private inholdings within park boundaries. Such activities must be coordinated and authorized prior to entry, through the respective agency or owner.
- Field personnel will carry a copy of their approved Scientific Research and Collecting permit at all times when engaged in data collection activities on park lands. This permit identifies times, places, and types of activities that are permitted and authorizes only activities that apply to the timeframe and content of the approved annual plan of work.
- NPS natural and cultural resource specialists will identify possible heritage or sensitive areas and assist Forest Service FIA personnel in developing strategies to avoid such areas while traversing to, or working within, field sample locations. This will require FIA sharing maps showing exact plot locations for planning and compliance purposes, but these maps will remain the sole property of FIA.
- NPS personnel will perform necessary NEPA and other compliance analyses as part of the NPS Scientific Research and Collecting Permit review and approval process.

Marking Samples and Locations

- Providing consistent and scientifically reliable resource data across all ownerships and classes of forest land in the United States is a hallmark of the Forest Inventory and Analysis research program. Measuring and recording methods on the NPS lands, however, must be sensitive to the existing character of these areas and leave as few signs of human disturbance as possible. Appropriate use of marking techniques will be identified in project-specific permit conditions, generally will include the permit number on the specified marking devices, generally will observe the following guidance, and will be enforced by FIA for field measurements in park areas:

Location Monumentation

- It is important to be able to relocate plots, subplots, and trees measured during the inventory. On the NPS lands, the following marking strategies will be used to minimize the visibility of FR plots, recognizing that local vegetation and terrain conditions may require different strategies, and that all strategies will be addressed in the permit conditions. Detailed, concise sketches, notes, and GPS locations where possible will also make subsequent relocation easier.
  - *Identifying tags/nails* - Marking tags/nails should be used minimally, painted an approved color, and face away from obvious trails and roads. Tags/nails may only be used at the base of the tree.
  - *Flagging* - Any flagging used to facilitate entry and exit from the plot area will be removed upon completion of the plot measurements.
  - *Painting/Scribing* - This practice will not be used (such as to monument the plot, identify witness trees, or to mark breast height).

Sample Plot Monumentation

o Monumentation of sample plots generally will observe the following constraints:

- *Starting point trees* - Starting Point or Reference Point trees will not be painted or scribed. Instead, nail a tag marked with "SP" or "RP" to the base of the tree facing the direction of normal approach. Describe the starting point on the plot sheet notes and include reference landmarks.
- *Subplot center* - Subplot centers are witnessed with a metal wire/rod in the ground as a marker which may not protrude from the ground more than 1 inch, unless local density of vegetation requires a different approach. Flagging may not be attached to the marker.
- *Subplot witness trees* - Witness trees will not be painted or scribed. Nail a tag with the letter X on it to the base of the tree facing subplot center.
- *Subplot reference trees* - Reference trees will not be painted or scribed. Nail a tag with the subplot number to the base of each reference tree.
- *Sample trees* - Sample trees will not be painted or scribed. Each sample tree 5.0" DBH and larger may have a tag placed at ground level either facing subplot center or on the uphill side of the tree if there is a slope. If the sample tree is in view of a known path or trail, place the tag away from the path or trail and note in the field tally. If only saplings are on the subplot mark a couple of them with nails at ground level and note which are so marked.

Boring Trees

o Boring or drilling will be done only when absolutely necessary to estimate site, age, or growth. (This will generally be the case only during initial establishment of permanent plots to assess site productivity.) Following on-site analysis, increment cores will be discarded on the ground, saved to be used and discarded after lab analysis, or saved for permanent retention in the park collection.

Cutting Vines and Moss

o Destructive sampling will not be done. In cases where vines or moss preclude the use of diameter tapes for estimation of diameter, calipers or other estimation procedures may be used. In these cases, field notes should identify trees with estimated diameters and the method used.

Specimen Collection

o Collecting under this MOU will be for scientific purposes only, and may not be used for personal or commercial purposes. In general, collections for scientific purposes removed from a site for more detailed analysis and classification will be destroyed following analysis. Forest Service FIA will maintain no voucher specimen collections. If any collection of voucher specimens becomes necessary, the approval to collect must be authorized in the Scientific Research and Collecting Permit.

o No archeological or paleontological materials may be collected. Upon location of any historical or archeological remains field work will cease and the site shall be reported immediately to the Park Manager. No disturbance of such a site is permitted. NPS personnel will assist Forest Service crews in identifying possible heritage sites and

will notify Forest Service crews of any potential heritage areas prior to entry.

Site Condition

- All refuse associated with field operations shall be removed from NPS lands and the site of any data collection or encampment shall be returned to the condition in which it was found, except as authorized by the Scientific Research and Collecting Permit.
- In some cases, the permit conditions may need to require additional special provisions for preventing the introduction into FIA plots of seeds, pathogens, or other propagules of exotic species.

  Soil disturbance is to be limited to necessary sampling as described in the RA inventory field instructions provided with the approved plan of work. Soil disturbance must be authorized by the Scientific Research and Collecting Permit and must be conducted in conformity with the provisions and conditions identified in the permit. Total sample volume per location usually will be limited to 2,500 cubic centimeters and all samples will be destroyed during or following analysis.
- Temporary markers, such as flagging, usually may not remain in place for more than one week when study teams are not present on a site. Paint, or similar semi permanent markers, may not be applied to rocks, plants, or other natural surfaces.

Wildlife Interaction

- Harassment, hazing, collecting, or other disturbance of wildlife is prohibited.
- Problem encounters with wildlife, including any experienced or observed incidents of wildlife harassing humans or obtaining food or garbage from humans, shall be reported promptly to the Park Manager.
- All food and garbage will be stored in sealed containers and under specified conditions approved by the Park Manager. Field personnel will prevent wildlife from obtaining any of their food or garbage.
- In Alaska parks, where possession of firearms may be approved under special conditions identified in the Scientific Research and Collecting Permit, such possession is restricted to only approved personnel who have successfully completed Forest Service and NPS approved training in both the use and safety of firearms and proper human behavior around bears and other potentially threatening wildlife. Firearms may be carried only for defense of life during periods of field work.

G. AUTHORIZATIONS. Each agency, respectively, is authorized by one or more of the following acts to perform the above activities:

- Act of August 25, 1916, 39 Stat. 535 as amended (The National Park Service Organic Act)
- Public Law 105-391 of November 13, 1998 112 Stat. 3497 (National Parks Omnibus Management Act of 1998)
- Public Law 88-577 of September 3, 1964. 78 Stat. 890. (Wilderness Act)
- Public Law 74-46 of April 27, 1935. 49 Stat. 163 (Soil Conservation and Domestic Allotment Act)
- Public Law 93-378 of August 17, 1974. 88 Stat. 476 (Resources Planning Act)
- Public Law 94-588 of October 22, 1976. 90 Stat. 2949 (National Forest Management Act)
- Public Law 95-307 of June 30, 1978. 92 Stat. 353 (Forest and Rangeland Renewable Resources Research Act- which repealed and replaced the Forest Service inventory mandate initially set forth in the McSweeney/McNary Act of May 1928)
- Public Law 95-313 of July 1, 1978. 92 Stat. 365 (Cooperative Forestry Assistance Act)
- Public Law 99-198 of December 23, 1985. 7 U.S.C. 2276 (Food Security Act)
- Public Law 100-521 of 1988. (Forest Ecosystems and Atmospheric Pollution Research Act)
- Public Law 84-159 (Title IX Amendments of the Clean Air Act of 1990)
- Public Law 105-185 of June 13, 1998. (16 U.S.C. § 1642 (e)) (Agricultural Research, Extension, and Education Reform Act- which amended the Forest and Rangeland Renewable Resources Research Act of 1978 and authorized the FIA program).

FS Agreement No. 13-MU-11132652-535

H. PRINCIPAL CONTACTS. Individuals listed below are authorized to act in their respective areas for matters related to this agreement.

Principal Cooperator Contacts:

Cooperator Program Contact	Cooperator Administrative Contact
Name: Raymond M. Sauvajot, Deputy Associate Director	Name: Karl Brown
Natural Resource Stewardship & Science	Biological Resource Management Division
Address: 1849 C Street NW, Room 3130	Address: 1201 Oakridge Drive
City, State, Zip: Washington, DC 20240	City, State, Zip: Ft. Collins, CO 80525
Telephone: 202-208-3884	Telephone: 970-225- 3591
FAX: 202-273-4431	FAX: 970-225-3585
Email: ray_sauvajot@nps.gov	Email: karl_brown@nps.gov

Principal U.S. Forest Service Contacts:

U.S. Forest Service Program Manager Contact	U.S. Forest Service Administrative Contact
Name: Richard Guldin, Director Science, Policy, Planning, Inventory & Information	Name: W. Brad Smith, Associate National Program Manager, Forest Inventory and Analysis Program
Address: 201 14th Street SW, 2nd Floor	Address: 201 14th Street SW, 2nd Floor
City, State, Zip: Washington, DC 20250	City, State, Zip: Washington, DC 20250
Telephone: 703-605-4177	Telephone: 703-605-4177
FAX: 703-605-5131	FAX: 703-605-5131
Email: rguldin@fs.fed.us	Email: bsmith12@fs.fed. us

I. NOTICES. Any communications affecting the operations covered by this agreement given by the U.S. Forest Service or the NPS is sufficient only if in writing and delivered in person, mailed, or transmitted electronically by e-mail or fax, as follows:

To the U.S. Forest Service Program Manager, at the address specified in the MOU.

To the NPS, at the Program Contact's address shown in the MOU or such other address designated within the MOU.

Notices are effective when delivered in accordance with this provision, or on the effective date of the notice, whichever is later.

J. PARTICIPATION IN SIMILAR ACTIVITIES. This MOU in no way restricts the U.S. Forest Service or the NPS from participating in similar activities with other public or private agencies, organizations, and individuals.

FS Agreement No. 13-MU-11132652-535

K. FREEDOM OF INFORMATION ACT (FOIA). Public access to this agreement and related records are subject to FOIA. Given that certain information related to this agreement may be exempt from public disclosure under FOIA, the parties agree to work to determine on a case-by-case basis whether specific information requested under FOIA can be publicly released. Accordingly, any party that receives a FOIA request related to this agreement agrees to notify the other party of the request prior to any determination to release or withhold records under FOIA.

L. NONBINDING AGREEMENT. The parties shall manage their respective resources and activities in a separate, coordinated and mutually beneficial manner to meet the purpose(s) of this MOU. Nothing in this MOU authorizes any of the parties to obligate funds or transfer anything of value.

Specific, prospective projects or activities that involve the transfer of funds, services, property, and/or anything of value to a party requires the execution of separate agreements.

Nothing in this MOU is intended to alter, limit, or expand the agencies' statutory and regulatory authority.

M. TEXT MESSAGING WHILE DRIVING. In accordance with Executive Order (EO) 13513, "Federal Leadership on Reducing Text Messaging While Driving," any and all text messaging by Federal employees is banned: a) while driving a Government owned vehicle (GOV) or driving a privately owned vehicle (POV) while on official Government business; or b) using any electronic equipment supplied by the Government when driving any vehicle at any time. All cooperators, their employees, volunteers, and contractors are encouraged to adopt and enforce policies that ban text messaging when driving company owned, leased or rented vehicles, POVs or GOVs when driving while on official Government business or when performing any work for or on behalf of the Government.

N. TERMINATION. Any of the parties, in writing, may terminate this MOU in whole, or in part, at any time before the date of expiration.

O. MODIFICATIONS. Modifications within the scope of this MOU must be made by mutual consent of the parties, by the issuance of a written modification signed and dated by all properly authorized, signatory officials, prior to any changes being performed. Requests for modification should be made, in writing, at least 30 days prior to implementation of the requested change.

P. COMMENCEMENT/EXPIRATION DATE. This MOU is executed as of the date of the last signature and is effective through **September 30, 2019** at which time it will expire.

Q. AUTHORIZED REPRESENTATIVES. By signature below, each party certifies that the individuals listed in this document as representatives of the individual parties are authorized to act in their respective areas for matters related to this MOU. In witness whereof, the parties hereto have executed this MOU as of the last date written below.

FS Agreement No. 13-MU-11132652-535

JONATHAN B. JARVIS, Director
National Park Service

6/25/14
Date

MAY 19 2014

THOMAS L. TIDWELL, Chief
U.S. Forest Service

Date

FS Agreement No. 13-MU-11132652-535

The authority and format of this agreement have been reviewed and approved for signature.

CLARK M. WOOLLEY, Grants Management Specialist
U.S. Forest Service

4/18/14
Date

Appendix K. Denali National Park and Preserve and Biosphere Reserve Foundation Document

The Denali Foundation Document can be found online at: https://www.nps.gov/dena/learn/management/upload/FoundationDoc_Denali_2014_corrected_final.pdf and is provided as a separate electronic attachment to this document.

Appendix L. Vital Signs Monitoring Plan

The Central Alaska Network Vital Signs Monitoring Plan can be found online at: https://science.nature.nps.gov/im/monitor/plans/CAKN_MonitoringPlan.pdf and is provided as a separate electronic attachment to this document.

Appendix M. State of the Park Report

The Denali National Park and Preserve State of the Park Report can be found online at: https://www.nps.gov/stateoftheparks/dena/DENA_StateOfThePark.pdf and is provided as a separate electronic attachment to this document.

Appendix N. Denali Subsistence Resource Commission Charter

A. OFFICIAL DESIGNATION.

The official designation of this Federal advisory committee is the National Park Service Subsistence Resource Commission for Denali National Park.

B. PURPOSES.

The purpose of the Commission is to devise and recommend to the Secretary and the Governor of Alaska a program for subsistence hunting within Denali National Park. Such program will be prepared using technical information and other pertinent data assembled or produced by necessary field studies or investigations conducted jointly or separately by the technical and administrative personnel of the State of Alaska and the U.S. Department of the Interior, information submitted by, and after consultation with the appropriate local advisory committees and federal regional advisory councils and any testimony received in a public hearing or hearings held by the Commission prior to preparation of the plan at a convenient location or locations in the vicinity of the national park. Each year thereafter, the Commission, after consultation with appropriate local committees and Federal regional advisory councils, considering all relevant data and holding one or more additional hearings in the vicinity of the park, will make recommendations to the Secretary and the Governor for any changes in the program or its implementation which the Commission deems necessary.

C. DUTIES AND POWERS.

The duties of the Commission are solely advisory, and are as stated in paragraph B above.

D. MEMBERSHIP.

1. The Commission will be composed of 9 members, as follows:

a. three appointed by the Secretary of the Interior to represent subsistence users;

b. three appointed by the Governor of the State of Alaska;

c. two appointed the by the Southcentral Federal Subsistence Regional Advisory Council, and one appointed by the Eastern Interior Federal Subsistence Regional Advisory Council, both councils established pursuant to Section 805 of P.L. 96-487 which have jurisdiction within Denali National Park. Each Federal Subsistence Regional Advisory Council appointee must be a member of either the Federal Subsistence Regional Advisory Council or a State local advisory committee within the region and also qualified to lawfully engage in subsistence uses within the national park.

2. Members will be appointed for 3-year terms. Vacancies on the Commission will be filled in the same manner as original appointments. If no successor is appointed on or prior to the expiration of a member's term, then the incumbent members will continue to serve until the new appointment is made. Members appointed by the Secretary under Paragraph D1a, will represent the interests of the subsistence users of the park.

3. Any member of the Commission who fails to attend three successive meetings of the

Commission or who otherwise fails to substantively participate in the work of the Commission, may be removed from the Commission by their appointing source (i.e., Secretary, Governor, or the appropriate Federal Subsistence Regional Advisory Council). Any vacancy on the Commission will be filled in the same manner in which the original appointment was made.

4. Each appointing source (i.e., Secretary, Governor, or the appropriate Federal

Subsistence Regional Advisory Council may appoint a voting alternate representative only in the event that the primary member is unable to attend the meeting.

5. Members of the Commission will serve without salary. However, while away from their homes or regular places of business in the performance of Commission business approved by the Designated Federal Official, members will be reimbursed for travel and per diem expense, in the same manner as persons employed intermittently in the Government service are allowed expenses under section 5703, Title 5 of the United States Code.

E. ETHICS RESPONSIBILITIES OF MEMBERS.

No Council or subcommittee member shall participate in any specific party matter including a lease, license, permit, contract, claim, agreement, or related litigation with the Department in which the member has a direct financial interest.

F. ADMINISTRATION.

1. CHARTER. The Commission is subject to the provisions of the Federal Advisory Committee Act (FACA), 5 U.S.C. Appendix (1994), and may take no action unless the charter filing requirements of Section 9 and 14(b) of the Act have been complied with. The provisions of Section 14 (b) of the FACA requiring a biennial rechartering are inapplicable to the Commission pursuant to Section 301 of Public Law 102-525, October 26, 1992. However, there will be a biennial review to determine if its purpose is being fulfilled.

2. DESIGNATED FEDERAL OFFICIAL. The Commission reports to the Superintendent of Denali National Park. Pursuant to Section 10(e) of the Federal Advisory Committee Act, the Designated Federal Officer will be the Superintendent of Denali National Park or a Federal employee designated by the Superintendent.

3. SUPPORT AND COSTS. Support for the Commission is provided by the National Park Service, Department of the Interior. The estimated annual operating cost of the Commission is $75,000, which includes ¼ work year of staff support.

4. CHAIRPERSON. The Chair of the Commission is elected annually by the members.

5. MEETINGS. Members of the Commission will meet approximately twice a year, or as often as circumstances require. The Commission shall not hold any meetings except at the call or with the advance approval of the Superintendent of Denali National Park. All meetings will be open to the general public. Any organization, association, or individual may attend or file a statement before the Commission regarding topics on a meeting agenda.

6. QUORUM. Five members constitute a quorum.

7. SUBCOMMITTEES. In carrying out its duties, the Commission may form subcommittees drawn in whole or in part from the full Commission, provided that the role of such subcommittees will be solely to gather information or conduct research for the Commission, toanalyze relevant issues and facts, or to draft proposed position papers for deliberation by the Commission. Any such committees are to be chaired by a voting member of the Commission. Membership on committees and meetings of committees are subject to approval by the DFO.

G. DURATION AND DATE OF TERMINATION.

In view of the objectives, scope and purposes of the Commission, it is expected to continue beyond the foreseeable future.

H. AUTHORITY.

The Commission has been established pursuant to 16 U.S.C. 3118, Public Law 96-487, title VIII, section 808(a) December 2, 1980.

/s/ Gale A. Norton 01/27/06

_____/_____

Secretary of the Interior Date Signed

01/31/06

DATE CHARTER FILED_____

Appendix O. References

Alaska Department of Environmental Conservation, Division of Air Quality. State Air Quality Plan. Updated June 2015. Available at: http://dec.alaska.gov/air/anpms/SIP/SIPhome.htm (accessed August 2016)

Albert, D. M. and R. T. Bowyer. 1991. Factors related to bear-human conflict in Denali National Park. *Wilderness Society Bulletin* 19: 339-349.

Betchkal, D. 2013. Acoustic monitoring report, Denali National Park and Preserve –2012. Natural Resource Data Series. NPS/DENA/NRDS—2013/589. National Park Service. Fort Collins, Colorado

Borg, B. and J. Burch 2013. Vital signs monitoring of wolf (*Canis lupus*) distribution and abundance in Denali National Park and Preserve, Central Alaska Network. Biological Year 2012 report. Natural Resource Data Series NPS/CAKN/NRDS 2013. National Park Service, Fort Collins, Colorado.

Collins, R. 2004. Dichinaknek'Hwt'ana: A history of the people of the upper Kuskokwim who live in Nikolai and Telida, Alaska. Natural Resource Technical Report and Natural Resource Data Series: version 2.1. NPS/NPRC/IMD/NRTR—2004. National Park Service, Fort Collins, Colorado

Coffman, S. C. 2011. Archaeology at Teklanika West (HEA-001): An Upland Archaeological Site, Central Alaska, University of Alaska Fairbanks, MA Thesis.

Curran, M. 2004. Cultural Landscape Inventory: Park Headquarters Historic District. Anchorage, AK: Cultural Landscapes Program Alaska.

Denali National Park and Preserve. 2008a. Reconstructing ecosystems of the Lower Cantwell: plants in the age of dinosaurs. DENA-FS-018-2008. Denali National Park and Preserve, Denali Park, Alaska. 2 pages.

Denali National Park and Preserve. 2008b. Paleoecology of Denali's dinosaurs. DENA-FS-022-2008. Denali National Park and Preserve, Denali Park, Alaska. 2 pages.

Denali National Park and Preserve. 2009. Long-term Monitoring after Restoration of Kantishna's Placer-Mined Streams. DENA-FS-032-2009. Denali National Park and Preserve, Denali Park, Alaska.

Denali National Park and Preserve. 2010. Restoration of Mined Lands in Kantishna. DENA-FS-033-2010. Denali National Park and Preserve, Denali Park, Alaska.

Denali National Park and Preserve. 2012. Fossil bird diversity. DENA-FS-057-2012. Denali National Park and Preserve, Denali Park, Alaska. 2 pages.

Denali National Park and Preserve. 2013. Discovery of Denali's first dinosaur track. DENA-FS-004-2013. Denali National Park and Preserve, Denali Park, Alaska. 2 pages.

Densmore, R. V. 2005. Succession on subalpine placer mine spoil: Effects of revegetation with Alnus viridis, Alaska, USA. *Arctic, Antarctic, and Alpine Research* 37(3): 297-303.

Department of the Interior (DOI). 2011. The Department of the Interior's Economic Contributions National Report. National Economic Technical Report. National Park Service, BLM, Bureau of Energy, USDA Economic Research Service: Lakewood, Colorado.

Duriscoe, D. M. and C. A. Moore. 2013. Night Sky Assessment for Denali National Park

and Preserve. Natural Resource Data Series Report, National Park Service, Fort Collins, Colorado.

Econorthwest 2011. The Economic Importance of Alaska's Wildlife in 2011 Summary Report. Natural Resource Economics, EcoNorthwest. Updated August 2011. Available at: https://www.adfg.alaska.gov/static/home/news/ongoingissues/pdfs/the-economic-importance-of-alaskas-wildlife-in-2011-summary-report.pdf (accessed August 2016)

Environmental Protection Agency (EPA). 2011. Restoring stream channel and floodplain reduces turbidity. Available at: http://water.epa.gov/polwaste/nps/success319/ak_caribou..cfm (accessed August 2016) Ferreira, S.L. 2009. Cultural Landscape Inventory: Nevesweat Prospect. Anchorage, AK: Cultural Landscapes Program Alaska.

Ferreira, S. L. and N. Mikesh. 2007. Cultural Landscape Inventory: Wonder Lake Ranger Station. Anchorage, AK: Cultural Landscapes Program Alaska.

Ferreira, S. L. and N. Mikesh. 2008a. Cultural Landscape Inventory: Fannie Quigley Residence. Anchorage, AK: Cultural Landscapes Program Alaska.

Ferreira, S. L. and N. Mikesh. 2008b. Cultural Landscapes Inventory: Busia Cabin. Anchorage, AK: Cultural Landscapes Program, Alaska.

Fiorillo, A. R. and T. L. Adams. 2012. A Therizinosaur track from the lower Cantwell formation (Upper Cretaceous) of Denali National Park, Alaska. *PALAIOS* 27: 395-400.

Flamme, M. J. and M. MacCluskie. 2012. Small-mammal monitoring in Denali National Park and Preserve, Central Alaska Network: 2012 Report. Fairbanks, Alaska.

Groves, D. J. 2012. The 2010 North American Trumpeter Swan Survey. Division of Migratory Bird Management, U.S. Fish and Wildlife Service, Juneau, Alaska. 26 pp.

Holen, S. and L. Williams. 2006. Wild Resource Harvests and Uses by Residents of Lake Minchumina and Nikolai, Alaska, 2001-2002. Alaska Department of Fish and Game TP 298. Alaska Department of Fish and Game, Juneau, Alaska.

Holmes, C. E. 1986. Lake Minchumina prehistory: an archeological analysis. Aurora monograph series, 2. Alaska Anthropological Association. Anchorage, AK

King, M. and G. Colligan. 2012. Wildlife-Human Conflict Management Summary, East District 2012. Denali National Park and Preserve, Denali Park, Alaska. 14 pp.

Klein. E. E., E. Berg, and R. Dial. 2005. Wetland drying and succession across the Kenai Peninsula Lowlands, south-central Alaska. *Canadian Journal of Forest Research* 35:1931-1941.

Landers, D. H., S. L. Simonich, D. A. Jaffe, L. H. Geiser, D. H. Campbell, A. R. Schwindt, C. B. Schreck, M. L. Kent, W. D. Hafner, H. E. Taylor, K. J. Hageman, S. Usenko, L. K. Ackerman, J. E. Schrlau, N. L. Rose, T. F. Blett, and M. M. Erway. 2008. The fate, transport, and ecological impacts of airborne contaminants in western national parks (USA). EPA/600/R-07/138. U.S. Environmental Protection Agency, Office of Research and Development, NHEERL, Western Ecology Division, Corvallis, Oregon.

McNay, M. E. 2002. Investigation of wolf population response to intensive trapping in the presence of high ungulate biomass. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Performance Report. Grant W-27-1 to 5. Study 14.17. Juneau, Alaska.

Murie, A. 1963. Birds of Mount McKinley National Park, Alaska. McKinley Park, Alaska: Mount McKinley Natural History Association.

Murie, A. 1981. The Grizzlies of Mount Mckinley. Univ. of Washington Press, Seattle. 251pp.

Norris, F. B. 2006b. Crown jewel of the north : an administrative history of Denali National Park and Preserve. Volume 2. Volume 2. Anchorage, Alaska: Alaska Regional Office, National Park Service, U.S. Dept. of the Interior.

Osterkamp, T. E. 2003. Establishing long-term permafrost observatories for active-layer and permafrost investigations in Alaska: 1977–2002. *Permafrost and Periglacial Processes* 14:331-342.

Owen, P. A. and R. Mace. 2006. Grizzly bear population ecology in Denali National Park and Preserve, Alaska. *Alaska Park Science* 6(2):66-68.

Owen, P. A. and T. J. Meier. 2012. 2011 Aerial Moose Survey, Denali National Park and Preserve. National Park Service, Denali Park, Alaska. 12 pp.

Pardo, L. H., M. E. Fenn, C. L. Goodale, L. H. Geiser, C. T. Driscoll, E. B. Allen, J. S. Baron, R. Bobbink, W. D. Bowman, C. M. Clark, B. Emmett, F. S. Gilliam, T. L. Greaver, S. J. Hall, E. A. Lilleskov, L. Liu, J. A. Lynch, K. J. Nadelhoffer, S. S. Perakis, M. J. Robin-Abbott, J. L. Stoddard, K. C. Weathers, and R. L. Dennis. 2011. Effects of nitrogen deposition and empirical nitrogen critical loads for ecoregions of the United States. *Ecological Applications* 21(8): 3049-3082.

Ring H. and W. Mahovlic. 2013. Invasive and exotic species management in Denali National Park and Preserve: 2012 Summary report. Natural Resource Data Series. NPS/DENA/NRDS—2013/426. National Park Service. Fort Collins, Colorado. Published Report-2192606.

Roland, C. and E. F. Nicklen. 2010. Aspen phenology monitoring in the Central Alaska Network of the National Park Service: Progress report 2010. Natural Resource Technical Report. NPS/CAKN/NRTR—2010/501. National Park Service, Natural Resource Stewardship and Science. Fort Collins, Colorado.

Roland, C., A. J. Schmidt, and E.Fleur Nicklen. 2013. Landscape-scale patterns in tree occupancy and abundance in subarctic Alaska. *Ecological Monographs* 83: 19-48.

Romanovsky, V. E., S. L. Smith, H. H. Christiansen, N. I. Shiklomanov, D. A. Streletskiy, D. S. Drozdov, N. G. Oberman, A. L. Kholodov, S. S. Marchenko 2012. Permafrost. 2012. In Jeffries, M. O., J. A. Richter-Menge and J. E. Overland, Eds., *Arctic Report Card 2012*, Available at: http://www.arctic.noaa.gov/reportcard (accessed August 2016)

Scenarios Network for Alaska and Arctic Planning, University of Alaska (SNAP-UAF). 2013. Climate Cahnge Summary eports of National Parks, Preserves, and Monuments. Available at: http://www.snap.uaf.edu/attachments/Denali_ClimSum.pdf (accessed February 2013)

Schmidt, J. H., C. L. McIntyre, and M. C. MacCluskie. 2013. Accounting for incomplete detection: What are we estimating and how might it affect long-term passerine monitoring programs? *Biological Conservation* 160:130-139.

Schmidt, J. H. and K. L. Rattenbury. 2013. Reducing effort while improving inference: Estimating Dall's sheep abundance and composition in small areas. *Journal of Wildlife Management* 77(5): 1048-1058.

Schuur, E. A. G., J. G. Vogel, K. Crummer, H. Lee, J. O. Sickman, and T. E. Osterkamp. 2009. The effect of permafrost thaw on old carbon release and net carbon exchange from tundra. *Nature* 459:556-559.

Stynes, D. J. 2011. Economic benefits to local communities from national park visitation and payroll, 2009. Natural Resource Report NPS/NRPC/SSD/ NRR—2011/281. National Park Service, Fort Collins, Colorado.

Stynes, D. J. and A. Ackerman. 2010. Impacts to Local Economy in Denali National Park and Preserve. NPS/NRDS–2010/260. National Park Service, Fort Collins, Colorado.

Walter, E. and W. Maholic. 2011. Invasive and exotic species management in Denali National Park & Preserve: 2011 Summary report. Natural Resource Data Series. NPS/DENA/NRDS—2011/220. National Park Service. Fort Collins, Colorado. Published Report-2181703.

Weddle, L. unpublished data [2012a]. Fire Weather Index (FWI) Lake Minchumina Duff Moisture Analysis 1994-2012. Denali Park and Preserve, Denali Park, Alaska. [spreadsheet that analyzes raw data from FWI]

Weddle, L. unpublished data [2012b]. Wildland Fire Management Information System (WFMI) Fire Reports Analysis 1952-2012. Denali Park and Preserve, Denali Park, Alaska. [spreadsheet that analyzes raw data from WFMI]

Williams, L., C. Venechuk, D. Holen, and W. Simeone. 2005. Lake Minchumina, Telida, Nikolai, and Cantwell Subsistence Community Use Profiles and Traditional Fisheries Use. Technical Paper 295. Alaska Department of Fish and Game, Juneau, Alaska.

Williams, L., et al. 2005. Lake Minchumina, Telida, Nikolai, and Cantwell subsistence community use profiles and traditional fisheries use: Alaska Department of Fish and Game, Division of Subsistence

Withers, J. and G. Adema. 2009. Soundscapes monitoring and an overflight advisory group: Informing real-time management decisions at Denali. *Park Science* 26(3):42-45.

ANNEX III. MAPS AND FIGURES

Appendix P. Maps

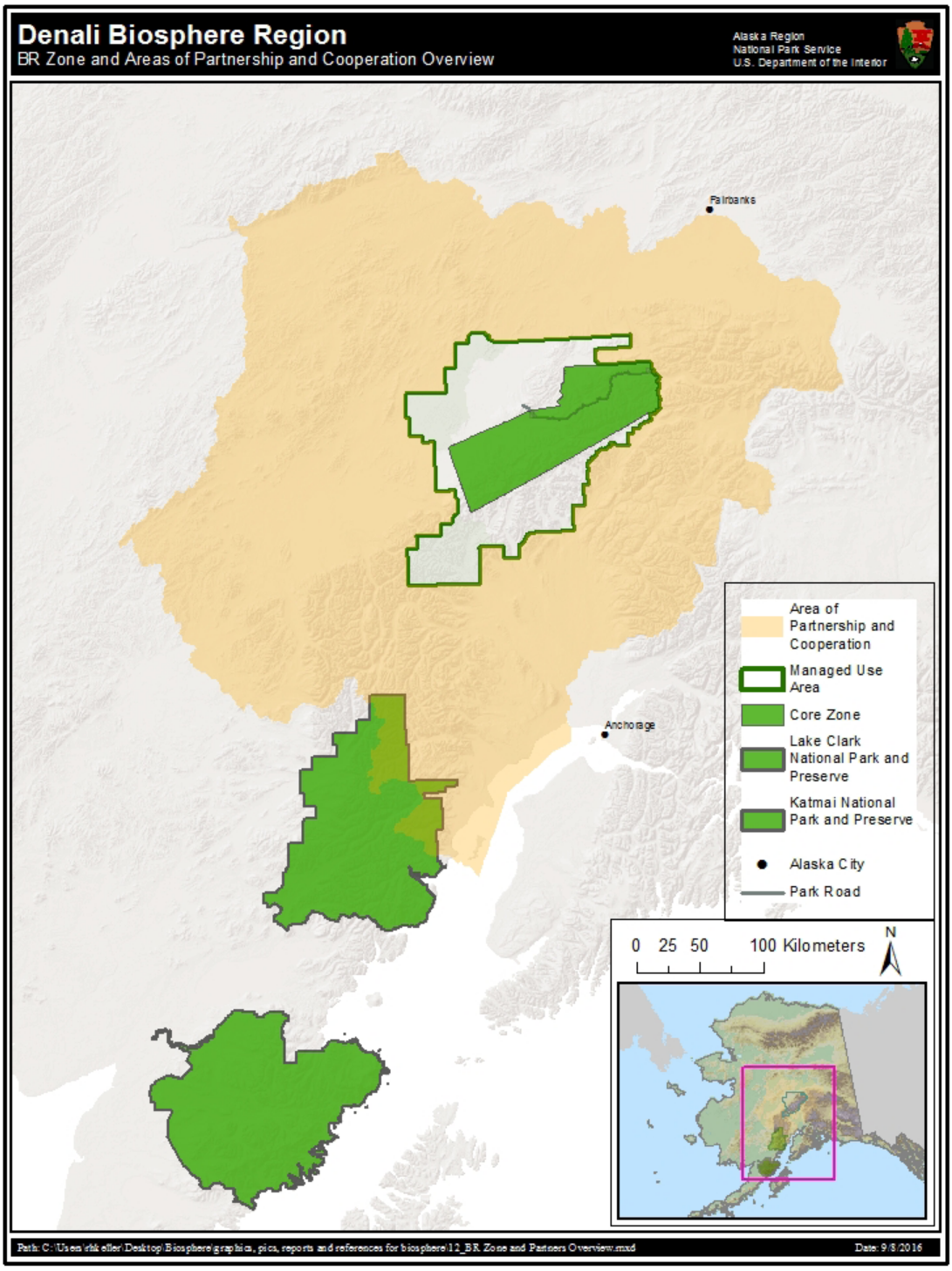


Figure 2.2.2. A map of Denali Biosphere Region Zone Overview.

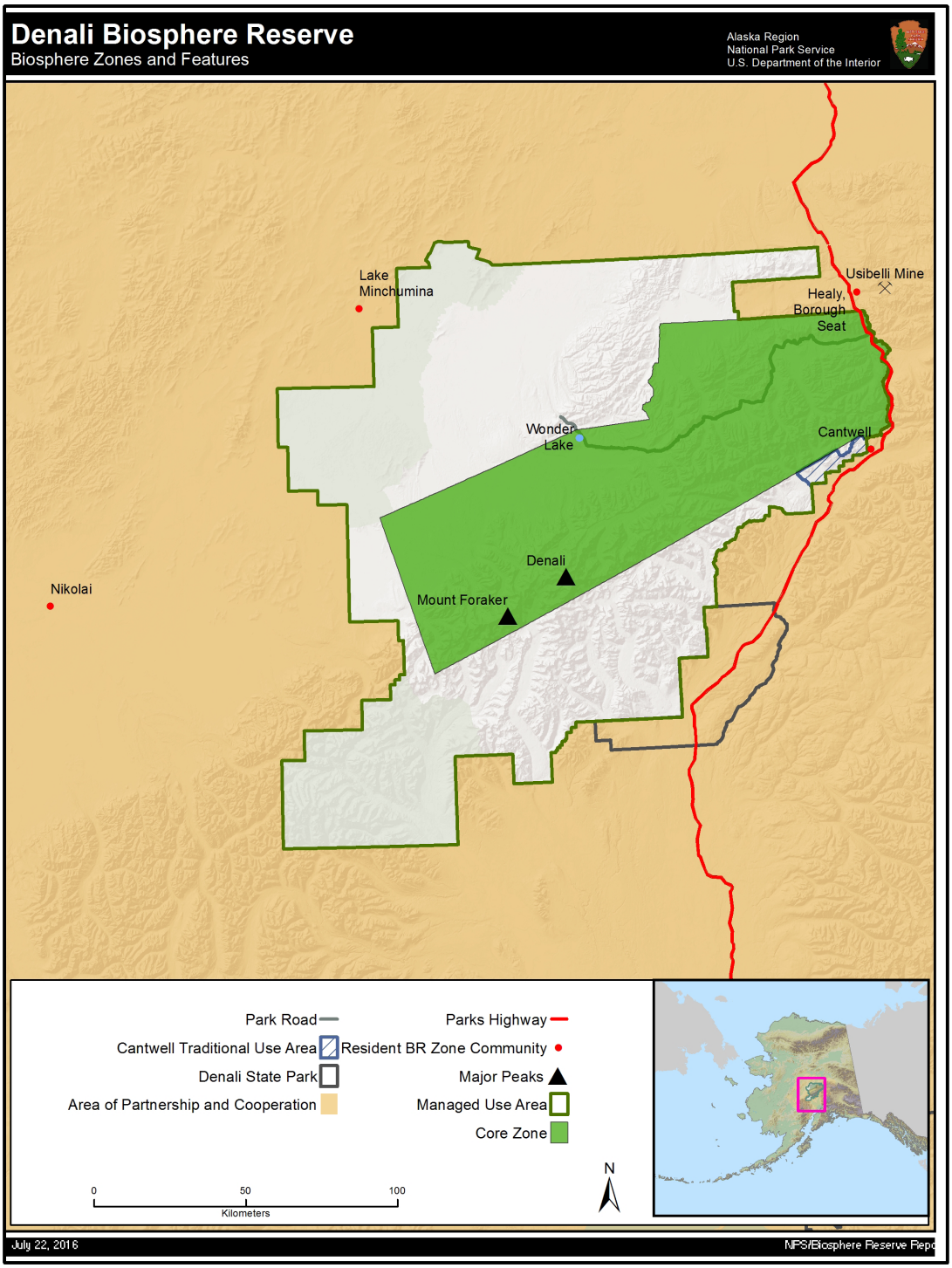


Figure 2.2.3. A map of Denali Biosphere Region Inner Zones and Features.

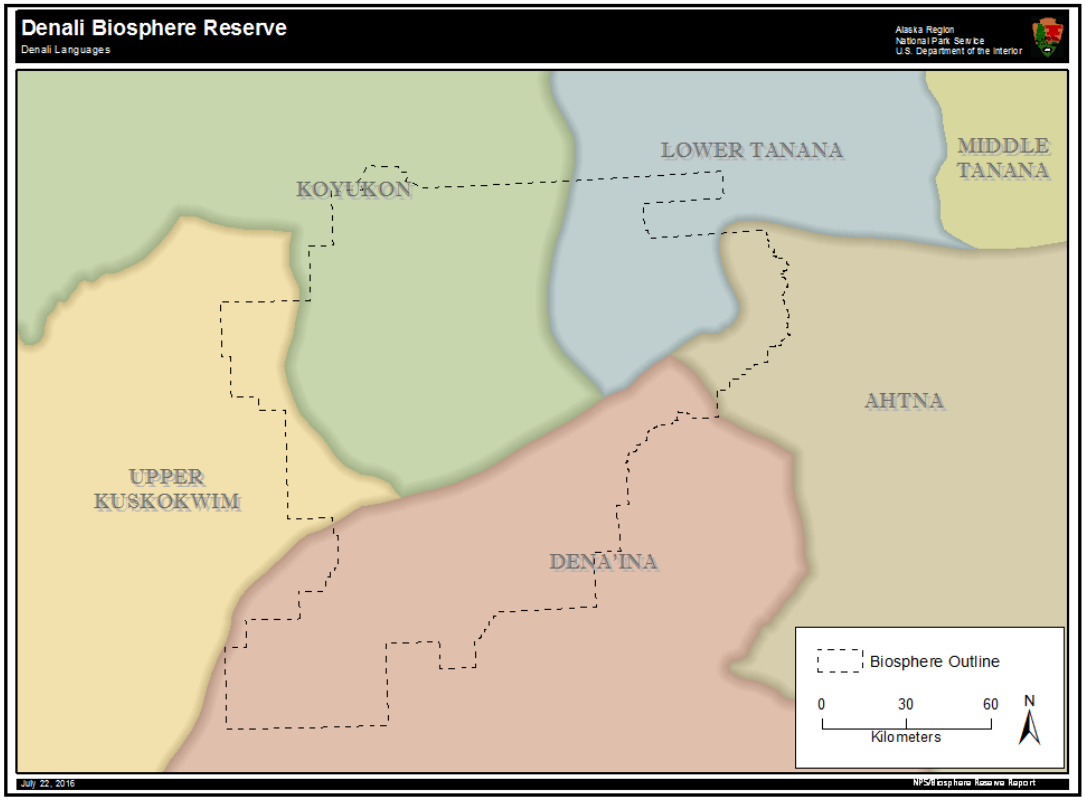


Figure 2.3.8. Denali Biosphere Reserve Athabascan Languages.

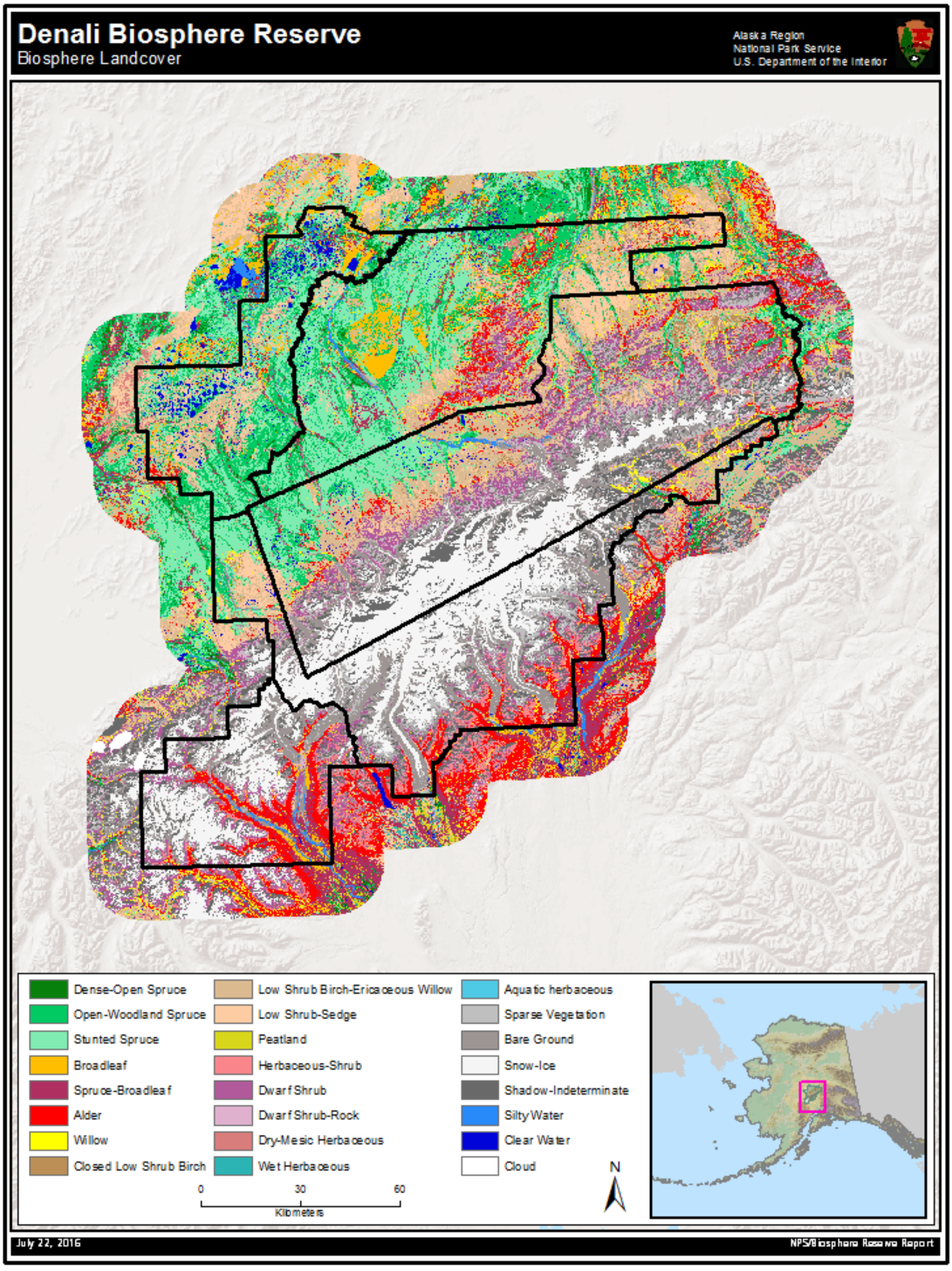


Figure 3.1 Denali Biosphere Region Land Cover.

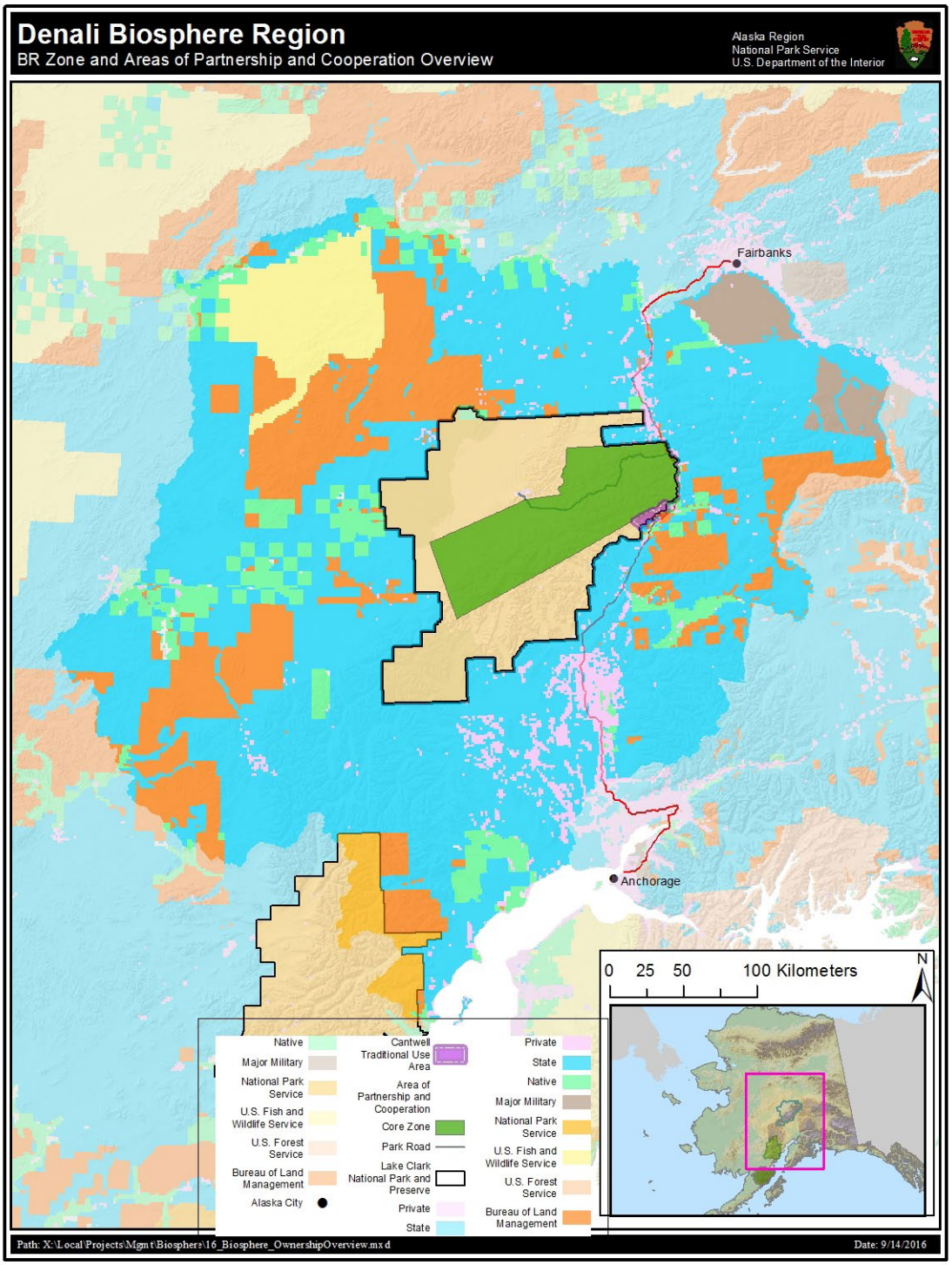


Figure 7.1. Denali Biosphere Region Areas of Partnership and Cooperation in Governance.

Appendix Q. Figures

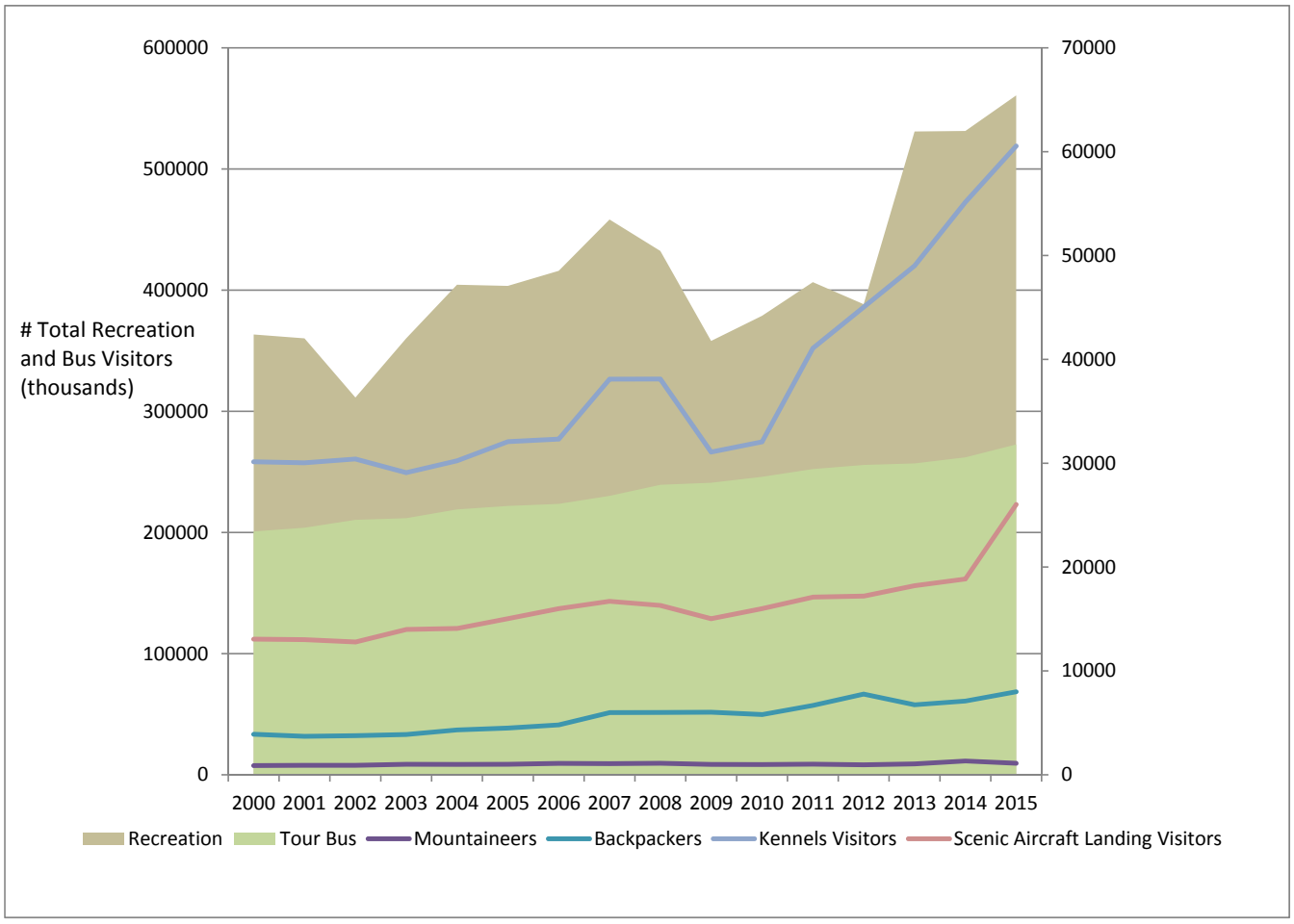


Figure 5.2. Tourism Trends in Denali BR. Number of individuals by year shown by activity: shuttle bus visitors in tens of thousands (left axis) and other recreation visitors in thousands (right axis) Source: Denali NPS Social Science Public Use Statistics Database.

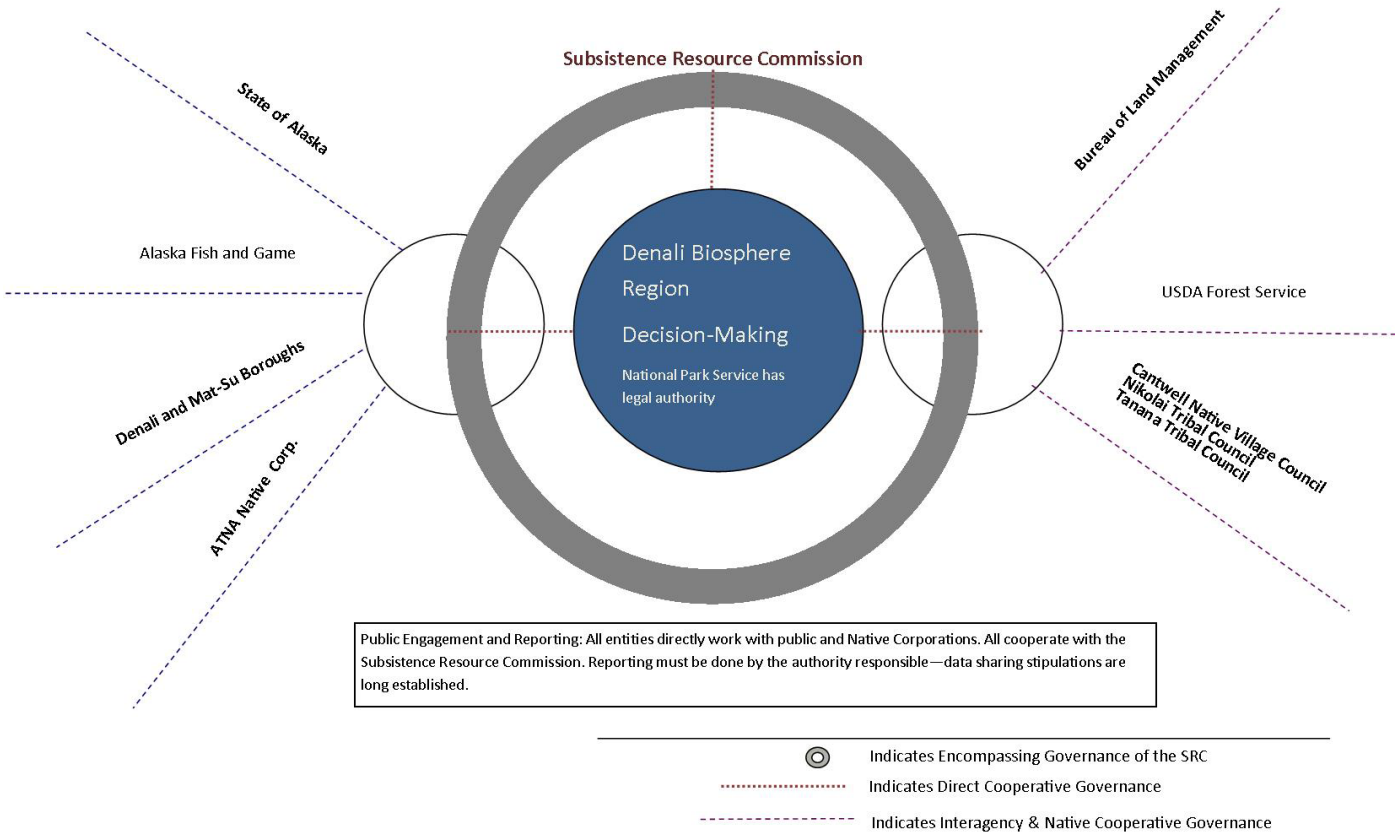


Figure 7.2. Denali Biosphere Region Governance Structure.

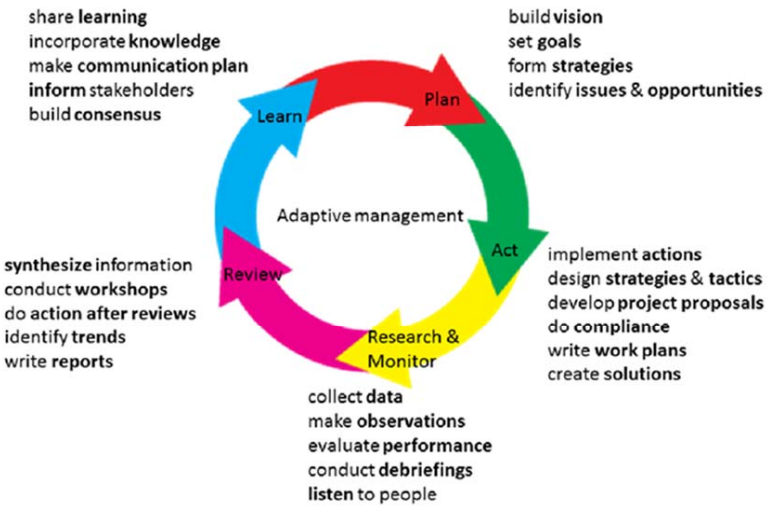


Figure 7.3. Adaptive management cycle of assessment.

Table 7.2.2. Criteria Summary and Framework for Denali Biosphere Region

Statutory Framework Article 4 Criterion number 5	Based on criteria from 2015 Rocky Mountain BR Periodic Review (Approved at the 28th session of the MAB-ICC in March 2016), the Denali Biosphere proposes the following nomenclature and system of geographic delineation.	Source of LEGAL AUTHORITY*	Denali Biosphere Region Authorities
(a) a legally constituted core area or areas devoted to long-term protection, according to the biosphere reserve, and of sufficient size to meet these objectives	One or more securely "Core Protected Areas" such as wilderness areas, for conservation and monitoring of minimally disturbed ecosystems. Denali's Core Protected Area is the Denali National Park Wilderness as designated in 1980,	Act of February 26, 1917, 39 Stat. 938; Act of January 30 1922, 42 Stat. 359; Act of July 7, 1958 P.L. 85-508, 72 Stat. 339, National Park Service Management Policies 2006; Code of Federal Regulations Title 43, 13	Act of February 26, 1917; P.L. 63-238, 39 Stat.938 Act of January 30 1922, 42 Stat. 359; Act of December 2, 1980 P.L. 96-487, 94 Stat. 2373;Wilderness Act of 1964; (additional Laws and policies pp 42-64 of Foundation Document)
(b) a buffer zone or zones clearly identified and surrounding or contiguous to the core area or areas, where only activities compatible with the conservation objectives can take place;	"Managed Use Areas" surrounding the protected areas, where research, educational activities, public recreation, and various economic activities occur according to ecological principles. The Denali Preserve and New (1980) park additions are designated as the Biosphere Region's Managed Use Area. Currently the delineated boundary of the Biosphere Region encompasses the Core Protected Area and the Managed Use Areas.	Act of November 14, 1997 P.L. 105-83, 111 Stat. 23; Act of May 8, 2008, P.L. 110-229, Act of January 28, 2013 P.L. 113-33 (additional Laws and policies in pp 42-64 of Foundation Document)	Act of February 26, 1917; P.L. 63-238, 39 Stat.938 (additional Laws and policies pp 42-64 of Foundation Document)
(c) an outer transition area where sustainable resource management practices are promoted and developed	"Areas of Partnership & Cooperation" are issue-driven partnerships or agreements, informed by science, to achieve a management outcome to protect the biosphere reserve (BR). A BR can have more than one issue-driven partnership that reflects the need such as air quality, migratory species, water quality, etc. The Area of Partnership and Cooperation is within Denali's Cooperative Ecosystem Studies Unit Footprint (Omnibus Management Act 1998), and the Department of Interiors Landscape Conservation Cooperative footprint (Dept. of Interior Secretary Order 3289). This zone includes lands owned and managed by the State of Alaska, the Bureau of Land Management, and a small amount of private land. Currently the delineated boundary of the Biosphere Region does not include the Areas of Partnership and Cooperation. However, these lands fully function as a transition zone as described in this periodic review. NPS will be working with partners from the State of Alaska and BLM to explore options	United States Code Title 54 has the work outside park authority for both Partnership & Cooperation. Bill Text: https://www.congress.gov/113/bills/hr106 8/BILLS-113hr1068rfs.pdf	Denali National Park and Preserve currently has more than 200 agreements with explicit cooperation or partnership. This documentation highlights three agreements - the Department of Interior Bureau of Land Management, the Department of Agriculture Forest Service, and the State of Alaska Fish and Game.

*per ARTICLE 2 number 3 of the MAB Statutory Framework - Individual biosphere reserves remain under the sovereign jurisdiction of the States where they are situated. Under the present Statutory Framework, States take the measures which they deem necessary according to their national legislation. The legal authorities described are the clear legal mandates provided for by the United States Congress AND best meet the expectations of both the form and especially the function outlined in the UNESCO MAB Statutory Framework. Additionally, the Areas of Partnership & Cooperation will continue to be formed as described and with the appropriate instruments with partners. Each area partnership will form a unique transition area where sustainable development, education, research, and resource management practices are collaboratively identified, developed, studied and implemented. Collectively a diversity of partnerships will add value to all entities and strengthen the functionality of the BR.

ANNEX IV. OTHER AGENCY/ENTITY LAND MANAGEMENT PLANS IN DENALI BIOSPHERE REGION

Appendix R. DOI BLM East Alaska Resource Management Plan

The DOI BLM East Alaska Resource Management Plan can be found online at: http://www.blm.gov/publish/content/ak/en/prog/planning/east_alaska_plan.html and is provided as a separate electronic attachment to this document.

Appendix S. Denali Borough Land Management Plan

The Denali Borough Land Management Plan can be found online at: http://www.denaliborough.govoffice.com/index.asp?SEC=DEEA5B13-7CD5-457B-ADD9-7053B7479F92&Type=B_BASIC and is provided as a separate electronic attachment to this document.

Appendix T. State of Alaska Department of Natural Resources Land Management Plan

The State of Alaska Department of Natural Resources Land Management Plan can be found online at: http://dnr.alaska.gov/mlw/planning/areaplans/susitna/ and is provided as a separate electronic attachment to this document.

Appendix U. Green Parks Plan

The Green Parks Plan can be found online at: https://www.nps.gov/greenparksplan/ and is provided as a separate electronic attachment to this document.

Appendix V. Denali Resource Stewardship Strategy

The Denali Resource Stewardship Strategy can be found online at: https://www.nps.gov/dena/learn/nature/rss.htm and is provided as a separate electronic attachment to this document.