National Park Service
U.S. Department of the Interior

State of the Park Report

Glacier Bay National Park and Preserve

Alaska

2017

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On the cover: Tidewater glacial landscape within Glacier Bay National Park and Preserve. NPS Photo.

Disclaimer. This State of the Park report summarizes the current condition of park resources, visitor experience, and park infrastructure as assessed by a combination of available factual information and the expert opinion and professional judgment of park staff and subject matter experts. The internet version of this report provides additional details and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytic approaches used in data collection and assessments of condition. This report provides evaluations of status and trends based on interpretation by NPS scientists and managers of both quantitative and non-quantitative assessments and observations. Future condition ratings may differ from findings in this report as new data and knowledge become available. The park superintendent approved the publication of this report.

Executive Summary

The mission of the National Park Service is to preserve unimpaired the natural and cultural resources and values of national parks for the enjoyment, education, and inspiration of this and future generations. NPS Management Policies (2006) state that "The Service will also strive to ensure that park resources and values are passed on to future generations in a condition that is as good as, or better than, the conditions that exist today." As part of the stewardship of national parks for the American people, the NPS has begun to develop State of the Park reports to assess the overall status and trends of each park's resources. The NPS will use this information to improve park priority setting and to synthesize and communicate complex park condition information to the public in a clear and simple way.

The purpose of this State of the Park report is to:

- Provide to visitors and the American public a snapshot of the status and trend in the condition of a park's priority resources and values;
- Summarize and communicate complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format;
- Highlight park stewardship activities and accomplishments to maintain or improve the State of the Park;
- Identify key issues and challenges facing the park to help inform park management planning.

The Purpose of Glacier Bay National Park and Preserve (GBNPP) is to protect a dynamic tidewater glacial landscape and associated natural successional processes for science and accessible discovery in a wilderness setting.

Significance statements express why the park unit's resources and values are important enough to warrant national park unit designation. GBNPP is significant because:

- Glacier Bay National Park and Preserve fosters unique opportunities for scientific studies of tidewater glacial landscapes and associated natural successional processes.
- Glacier Bay National Park and Preserve gathers and protects records of exploration, scientific endeavor and human use, and provides for understanding the landscape through the lens of human experience and study.
- Glacier Bay National Park and Preserve protects ecological integrity by preserving a diversity of large, contiguous, intact ecosystems (from the highest peaks of the Fairweather Range to the open Pacific Ocean and sheltered inland fjords) that are strongly dominated by natural processes.
- Glacier Bay National Park and Preserve protects a natural biophysical landscape that is continually changing through large-scale natural disturbance followed by the biological succession of plants and animals, and accompanied by an evolving physical environment.
- Glacier Bay National Park preserves one of the largest units of the national wilderness preservation system, encompassing more than 2.7 million acres of glacially influenced marine, terrestrial, and freshwater ecosystems.
- Glacier Bay National Park preserves one of the largest (nearly 600,000 acres) areas of federally protected marine ecosystems in Alaska (including submerged lands) against which other less protected marine ecosystems can be compared.
- Glacier Bay National Park and Preserve lies within two Tlingit ancestral homelands that are of cultural and spiritual significance to living communities today.
- Glacier Bay National Park provides diverse opportunities for visitors to experience a dynamic tidewater glacial landscape.
- Glacier Bay National Park and Preserve protects the remote and wild character of the Alsek River as a significant route of discovery and migration through the coastal mountain range to the Pacific Ocean.
- Glacier Bay National Preserve protects a productive, evolving, glacial outwash ecosystem at the terminus of the Alsek River and provides a setting for subsistence uses, commercial fishing activities, and hunting as outlined by the Alaska National Interest Lands Conservation Act (ANILCA).

The summary tables, below, and the supporting information that follows, provide an overall assessment of the condition of priority resources and values at GBNPP based on scientific and scholarly studies and expert opinion. The internet version of this report, available at https://www.nps.gov/stateoftheparks/glba/, provides additional detail and sources of information about the resources summarized in this report, including references, accounts on the origin and quality of the data, and the methods and analytical

approaches used in the assessments. Reference conditions that represent "healthy" ecosystem parameters, and regulatory standards (such as those related to air or water quality) provide the rationale to describe current resource status. In coming years, rapidly evolving information regarding climate change and associated effects will inform our goals for managing park resources, and may alter how we measure the trend in condition of park resources. Thus, reference conditions, regulatory standards, and/or our judgment about resource status or trend may evolve as the rate of climate change accelerates and we respond to novel conditions. In this context, the status and trends documented here provide a useful point-in-time baseline to inform our understanding of emerging change, as well as a synthesis to share as we build broader climate change response strategies with partners.

The Status and Trend symbols used in the summary tables below and throughout this report are summarized in the following key. The background color represents the current condition status, the direction of the arrow summarizes the trend in condition, and the thickness of the outside line represents the degree of confidence in the assessment. In some cases, the arrow is omitted because data are not sufficient for calculating a trend (e.g., data from a one-time inventory or insufficient sample size).

Condition Status		Trend in Condition		Confidence in Assessment	
	Warrants Significant Concern		Condition is Improving		High
	Warrants Moderate Concern		Condition is Unchanging		Medium
	Resource is in Good Condition		Condition is Deteriorating		Low

Park Fundamental Resources and Values Synthesis Table

The following table is presented before the State of the Park Summary to synthesize the condition of park resources in a way that corresponds to the Fundamental Resources and Values and Other Important Resources and Values in Glacier Bay's Foundation Statement. The information in the Rationale column is based upon one or more indicators in the State of the Park Report and the tables in Chapter 2. This Synthesis Table highlights those resources specific to the legislative authorizations of Glacier Bay.

Priority Resource or Value	Condition Status/Trend	Rationale
Scientific Investigation		*Glacier Bay National Park and Preserve fosters unique opportunities for scientific studies of tidewater glacial landscapes and associated natural successional processes.* The opportunity for scientific research in the park is in good condition. Interesting and important scientific questions with the potential for major contributions to science abound, many are being actively pursued, and the NPS is providing many opportunities for research.
Prehistoric and Historical Sites and Records		*Glacier Bay National Park and Preserve gathers and protects records of exploration, scientific endeavor and human use, and provides for understanding the landscape through the lens of human experience and study.* The park's performance in documenting and preserving prehistoric and historical sites and records and sharing that with the public is good. Significant work is still needed, especially in meeting national standards of record keeping.
Ecological Integrity		*Glacier Bay National Park and Preserve protects ecological integrity by preserving a diversity of large, contiguous, intact ecosystems (from the highest peaks of the Fairweather Range to the open Pacific Ocean and sheltered inland fjords) that are strongly dominated by natural processes.* GBNPP is a park with a dynamic and changing landscape. Significant concern related to the park's ecological integrity is triggered by recent climate change-related reductions in glaciers and the negative effects of ocean acidification. Other aspects of ecological integrity are good and the park represents a pristine system with minimal impacts of other human activities on ecological integrity.

Priority Resource or Value	Condition Status/Trend	Rationale
Dynamism and Succession		*Glacier Bay National Park and Preserve protects a natural biophysical landscape that is continually changing through large-scale natural disturbance followed by the biological succession of plants and animals, and accompanied by an evolving physical environment.* Significant park concern exists that successional processes are being affected by anthropogenic climate change. However, other human impacts on successional processes are minimal and the park represents a pristine system. The difficulty in distinguishing acceptable natural variability in dynamic processes from anthropogenic-driven change and impacts remains a challenge for the park and the NPS.
Wilderness		*Glacier Bay National Park preserves one of the largest units of the national wilderness preservation system, encompassing more than 2.7 million acres of glacially influenced marine, terrestrial, and freshwater ecosystems.* While there is concern about both the natural quality of wilderness and the future ability to conduct research in a wilderness setting due to climate change and ocean acidification, the remaining characteristics of wilderness remain in good condition.
Protected Marine Ecosystems		*Glacier Bay National Park preserves one of the largest (nearly 600,000 acres) areas of federally protected marine ecosystems in Alaska (including submerged lands) against which other less protected marine ecosystems can be compared.* Glacier Bay remains one of the most protected marine ecosystems and the park continues to increase these protections. Commercial fishing is being phased out, more sophisticated protections for visitor conflicts are being implemented, and many marine species are doing well. However, the Park has significant concern with the impacts of ocean acidification for which Glacier Bay is especially vulnerable.
Tlingit Ancestral Homelands		*Glacier Bay National Park and Preserve lies within two Tlingit ancestral homelands that are of cultural and spiritual significance to living communities today.* The park has achieved significant success in increasing the cultural significance of Glacier Bay to the Tlingit and in sharing that culture to the visiting public. Overall, the condition is good and improving.
Visitor Experience		*Glacier Bay National Park provides diverse opportunities for visitors to experience a dynamic tidewater glacial landscape.* Overall, the condition of the visitor experience opportunities is good. The park has very high visitor satisfaction and has one of the most successful interpretive operations within the NPS. Cruise tourism attracts a diverse (ethnic, family, economic, etc.) population and there are multiple ways for visitors to experience the park. While the overall condition is good, concern exists on visitor experience in the front country and private boater access.
Alsek River		*Glacier Bay National Park and Preserve protects the remote and wild character of the Alsek River as a significant route of discovery and migration through the coastal mountain range to the Pacific Ocean.* The natural condition and visitor experience on the Alsek is good. International cooperation remains high. Future changes in climate may negatively affect the visitor experience, but is not currently detected.
Glacier Bay Preserve		*Glacier Bay National Preserve protects a productive, evolving, glacial outwash ecosystem at the terminus of the Alsek River and provides a setting for subsistence uses, commercial fishing activities, and hunting as outlined by the Alaska National Interest Lands Conservation Act (ANILCA).* The condition of subsistence opportunities, commercial fishing opportunities and recreational visitor experience are good. Some concerns exist regarding future effects of climate change, and whether visitor commercial services are adequate given changes in visitor patterns.

State of the Park Summary Table

Priority Resource or Value	Condition Status/Trend	Rationale
Natural Resources		web ▸
Air Quality		The air quality of Southeast Alaska is generally believed to be among the most pristine in the world due to its low population densities, lack of large-scale industrial development, and vast wildland areas. However, air quality is currently threatened by both global industrial pollution and local sources, such as cruise ships. Data are lacking to provide assessments of visibility and ozone. Wet nitrogen deposition is low, but is based on data from a station relatively far (40km) from GBNPP. Wet sulfur deposition and mercury/toxics deposition levels warrant moderate concern based on potential impacts to high-elevation lakes and headwater streams.
Landscape Features and Processes		GBNPP is a park with a dynamic and changing landscape. Significant concern related to the park's landscape features and processes is triggered by recent climate change-related reductions in glaciers and the negative effects of ocean acidification. Continued reductions in glacial extent and volume may result in increased addition of freshwater melt to the marine waters, exacerbating ocean acidification processes. The difficulty in distinguishing acceptable natural variability in dynamic processes from anthropogenic-driven change and impacts remains a challenge for the park and the NPS.
Habitats and Communities		Overall, the park's habitats and communities are in good condition. Some exceptions exist for specific indicators (shore pine density, non-native plants potential to adversely affect native plant communities, and human impacts to natural processes in the intertidal/supratidal region). Moreover, because research is typically focused on habitats and communities suspected to be threatened or impacted, data about healthy communities may be lacking. The uncertainty involved with attributing landscape changes to anthropogenic causes in the context of the park's natural dynamism, makes assigning appropriate condition trends a challenge.
Water Quality		Overall, the park's water quality and water chemistry is in good condition. There are moderate concerns in the areas of freshwater and marine contaminants, specifically methylmercury and polycyclic aromatic hydrocarbons (PAHs). Peatland-rich older watersheds convert mercury to methylmercury, which is easily assimilated by aquatic organisms; methylmercury levels may rise in GBNPP as watersheds age. Localized elevated PAHs appear to be caused by vessel activity and related operations.
Terrestrial Mammals		Key terrestrial mammals (black bears, brown bears, moose, and mountain goats) are in good condition, with distribution patterns matching expectations within the various suitable habitats of GBNPP. Distribution patterns are expected to change over time due to changing landscape conditions following glacial recession and vegetation succession. There is limited data on abundance levels of terrestrial mammals, with more information in the Gustavus forelands (just outside the park) where bears and moose are hunted. Harvest levels of brown bears within the Preserve have increased over time, with a mean annual harvest of 8.3 bears (2001–2010).

Priority Resource or Value	Condition Status/Trend	Rationale
Marine Mammals		Marine mammals are the only natural resource category that is collectively showing a good condition that is increasing over time. In particular, humpback whales (4.4% annual population increase over 1985–2009), sea otters (21.5% annual population increase over 1993–2012) and Steller sea lion (16.6% annual population increase over 1991–2009 at S. Marble Island) abundances have increased and distribution generally matched availability of food resources. In the case of sea otters, overall distribution has expanded as otters continue to colonize Glacier Bay after being reintroduced to southeastern Alaska in the late 1960s. Recently, the majority of humpback whales and one population segment of Steller sea lions have been removed from the Endangered Species List. Harbor seals are the only natural resource indicator (besides glaciers) that warrant significant concern due to the decline in the population since monitoring started in 1992. Nevertheless, the more recent trend estimates suggest a decrease in the rate of the declines.
Birds		The abundance of Kittlitz's and Marbled Murrelets in Glacier Bay NPP constitutes a significant portion of the global populations for these species. Glaucous-winged gulls are of interest due to future harvest of eggs by Huna Tlingit users. Gull distribution has changed over time due to vegetation succession and their abundance has exhibited high variability. Current distribution observations match areas of nesting habitat, which bodes well for species success. Information on breeding landbirds is limited (a single assessment done over a decade ago) indicating high species richness and abundance in younger deciduous habitats.
Amphibians, Marine Fishes and Invertebrates		Population numbers of most marine fishes and invertebrates that are harvested species are of moderate concern, including Pacific halibut, rockfish, weathervane scallops and Tanner crabs. Rockfish are of particular concern due to their life history (long-lived and slow growing). Many of the directed rockfish fisheries are closed due to low stock abundance. For Pacific halibut, past declines in stock abundance, size at age, anecdotal reports of local depletion and environmental change are all cause for moderate concern. Landscape change resulting from glacial recession and land uplift alters the spawning and rearing habitat of salmon; however, salmon continue to colonize recently de-glaciated streams of the bay. Although the data are limited for small schooling fish and zooplankton, their distribution and abundance are good. Tanner crabs are of concern due to overall declines in stock biomass and the increased incidence of Bitter Crab Syndrome. Weathervane scallops show declining harvest rates (harvest over the most recent decade has declined by a quarter to nearly half of the historical average compared with the previous decade (1995–2004)) and a recent reduction in size. Data on western toads are limited; however, indications are that this species is declining, possibly due to Chytrid fungus and habitat changes.
Dark Night Sky		A photic environment is described as the physical amount and character of light at a particular location, irrespective of human perception. The NPS Night Sky Program characterizes a park's photic environment by measuring both anthropogenic and natural light. While no ground based or modeled data are available for Glacier Bay National Park and Preserve, 2012 visible infrared imaging radiometer (VIIRS) satellite data, which uses a broadband imaging detector with high sensitivity, indicates that there is no visible upward radiance within the park boundary. The most significant sources of upward radiance in the region originate from Juneau, AK and Whitehorse Canada.

Priority Resource or Value	Condition Status/Trend	Rationale
Acoustic Environment		Main sources of anthropogenic noise in GBNPP include vessel traffic, aircraft, and operations in the developed area of Bartlett Cove. The atmospheric soundscape is assumed to be in generally good condition although quantitative studies have not been conducted. The underwater soundscape is degraded by vessel noise that strongly influences the underwater acoustic environment with a noticeable seasonal and diurnal pattern. These degraded underwater sound conditions, the potentially low amount of time without vessel noise, and a loss of communication space may adversely impact the vocal marine mammal populations in the bay.
Scientific Research		As a "priority park value," the opportunity for scientific research in the park is in good condition. Interesting and important scientific questions with the potential for major contributions to science abound, many are being actively pursued, and the NPS is providing many opportunities for research. Managers are generally satisfied with the research-generated information that they depend on for decision-making and adaptive management. However, while the overall amount of research and opportunity for research is unchanged and in good condition, some specific research priority areas (e.g., successional, fisheries, and benthic ecological research) have seen significant declines.
Cultural Resources		web
Archeological Resources		Comprehensive archeological surveys conducted in 2013 and 2014 increased the number of archeological sites located and documented to 146. During the 2013 and 2014 archeological surveys, staff relocated and documented the condition of some previously identified sites and found all to be in good condition. Those sites that have not been evaluated in the past five years are thought to be in similar condition. NPS archeologists estimate that 25% of appropriate coastline has been surveyed.
Cultural Anthropology and Tlingit Connection to Ancestral Lands		The park has not completed baseline ethnographic documents including an Ethnographic Overview and Assessment, but has conducted considerable ethnographic research. Ethnographic information informs park planning and programming efforts and park staff has extensive expertise and knowledge of local ethnographic resources. However, little ethnographic research has been published to date, and there is moderate concern that it will become increasingly difficult to access over time. The park has focused considerable efforts and resources toward assisting traditionally associated people to maintain and strengthen their connection to ancestral homelands in GBNPP. The majority of cultural resource staff time focuses on building and maintaining partnerships with native entities such that traditional knowledge is available, transmitted, and used in order to maintain the integrity of the human relationship with place. The park has sponsored and/or co-sponsored numerous workshops, activities, and programs focused on gathering and transmitting traditional knowledge in both Hoonah and Yakutat. Such NPS-sponsored efforts have ensured that many tribal members engage in traditional activities in homeland; however, the cost and logistics of accessing GBNPP make it difficult for tribal members to visit on their own.
Cultural Landscapes		Nine cultural landscapes have been identified. Inventories for three (40%) have been completed. Six other cultural landscapes have been identified but have not been documented: Undocumented landscapes include: Berg Bay, Cape Spencer, Dry Bay, Excursion Inlet, Ibach Cabin/Garden Remains, and Lituya Bay.
Historic Structures		The park has recorded 38 historic structures and most are managed under the park's General Management Plan policy of benign neglect of historic structures in wilderness areas. None of the historic structures in the park has adequate National Register documentation. The integrity of the Glacier Bay Lodge complex is deteriorating due to significant deferred maintenance. One historic structure (Lagoon Island Cabin) needs to be stabilized and is in poor condition.

Priority Resource or Value	Condition Status/Trend	Rationale
History		Recent administrative history and fundamental changes to park programs have not been well documented. Administrative records need to be completed and archived.
Museum Collections		All park collections documents are outdated or non-existent. Approximately 50% of the park's accession and deaccession files are incomplete and 50% of the park's archival collection is not incorporated into the established NPS hierarchy and databases and must be re-cataloged.
Visitor Experience		web
Number of Visitors		With 551,353 visitors to the park in 2015, visitation numbers follow a steady increase of 20% over the last 5 years. The vast majority of park visitors (95%) arrive on cruise ships and tour boats, cruising Glacier Bay for one day as part of a longer Inside Passage itinerary.
Visitor Satisfaction		Based on the standard visitor satisfaction survey conducted each year, park visitors are very satisfied with Glacier Bay's facilities and services. The percentage of visitors satisfied in FY14 was 98%. Over the past five years, Glacier Bay has consistently achieved satisfaction scores of 96–99%.
Interpretive and Education Programs – Talks, Tours, and Special Events		GBNPP offers unique opportunities for rangers to provide programs to a wide audience on ships, boats and land. Interpretive contacts have increased from 663,565 in 2011 to 783,096 in 2015. Glacier Bay provides the highest number of facilitated interpretive programs in the AK Region.
Interpretive Media – Brochures, Exhibits, Signs, and Website		Glacier Bay NPP offers visitors the opportunity to learn and enhance their visit through professional exhibits, waysides, and online offerings. Glacier Bay's visitor center is dated and warrants renovation. The park's website is professional and updated.
Recreational Opportunities		Glacier Bay NPP offers a diverse range of recreational opportunities to visitors. Protected wilderness waters, spectacular wildlife, dynamic glaciers, and superlative scenery provide for unique Alaskan experiences. Popular activities include kayaking, fishing, boating, photography, hiking, and glacier viewing. There is overall management concern in ensuring that current opportunities and facilities meet the needs of changing visitation and use patterns.
Accessibility		Tour boats and cruise ships provide tremendous park access to over 95% of park visitors. These ships are all ADA accessible and provide support for visitors of all abilities. Significant improvement has occurred over the past few years in Bartlett Cove, and all new media produced is ADA compliant.
Safety		Improvements in safety equipment, training, and communications lead to overall safer park operations. The park continues to work to identify potential hazards and mitigate risks.
Partnerships		All divisions in the park benefit from the work of volunteers. The number of volunteers and hours contributed is significant. Glacier Bay NPP continues to work with a number of official and unofficial partners to accomplish various goals and strengthen relationships.
Scenic Resources		Remote and wild, the views enjoyed by park visitors are protected in all directions.

Priority Resource or Value	Condition Status/Trend	Rationale
Park Infrastructure		web
Overall Facility Condition Index		The 231 assets at Glacier Bay have an overall Facility Condition Index (FCI) of 0.049, which is "Good" based on industry and NPS standards. However, changes in Facility Condition Indices, changes in FMSS reporting requirements, and possible data errors significantly skew park FCI data. GBNPP has had several revisions to the appraised replacement value of park assets since 2010, which also makes the data problematic.
Sustainability		The park is working to increase sustainability, including exploring hydropower as a source of electricity, saving water by keeping plumbing in good repair, and by aggressive recycling practices.
Wilderness Character		web
Overall Wilderness Character		Overall, the vast wilderness of GBNPP is in pristine condition. The condition of the natural quality is good. However, there are ongoing impacts to the natural quality associated with global climate change and other far-field anthropogenic activities, but lack of information limits our confidence in assessing the magnitude of impacts. Undeveloped and untrammeled qualities are either improving or unchanging, and in good condition. Solitude and primitive and unconfined recreational opportunity quality is good. Opportunities for scientific research in a natural setting remain abundant.
Subsistence Use and Commercial Fish Harvest		web
Subsistence Use		Subsistence resources are in good condition. Harvest is monitored and managed for primary species through a variety of mechanisms, including in-season management and harvest permits. History of use and cultural importance of the area is a focus for the NPS and the community of Yakutat.
Commercial Fish Harvest		Access to up-to-date fisheries participation and harvest information for fisheries occurring within and adjacent to Glacier Bay NPP is challenging due to reporting schedules and delayed information availability, the state of AK confidentiality statute limiting access to information associated with low effort fisheries, poor count area alignment with the NPS boundary and the variability in reporting metrics (i.e., poundage vs. fish numbers) among sectors (i.e., commercial vs. recreational). However, fisheries participation and harvest information is generally available to park managers at larger spatial scales one to two years after fishery openings. The confidentiality statute will ultimately preclude NPS access to Bay proper fishery harvest information when the number of Lifetime Access Permit fishery participants drops below the confidentiality limit (i.e., 3 permit holders). Good opportunity to harvest fish and invertebrates exists. However, harvest opportunity is mediated by species distribution, variation in stock abundance and state or federal fishery management. Most fisheries, with a few exceptions (i.e., weathervane scallop and Tanner crab rings), are limited entry, which restricts fishery participation and harvest capacity. Fishery opening duration varies by fishery with openings ranging from a few days (i.e., Tanner crab) to several months each year. While commercial fishing within Glacier Bay Proper is limited to qualifying Lifetime Access Permit holders, access to outside waters fisheries is less restricted by NPS regulations. With the exception of associated bycatch and occasional marine mammal entanglement or hooking impacts, non-target species commercial fishing impacts remain largely undocumented.

Summary of Stewardship Activities and Key Accomplishments to Maintain or Improve Priority Resource Condition

The list below provides examples of stewardship activities and accomplishments by park staff and partners to maintain or improve the condition of priority park resources and values for this and future generations:

Natural Resources

- Collaborated on research projects addressing key management issues related to vessel operations in the bay with a number of outside institutions, including: vessel-generated acoustic impacts on marine mammals, ship-whale interactions, vessel-based disturbance of seals and Kittlitz's Murrelets, and air emissions impacts from cruise ships.
- Completed draft of proposed regulation changes that would include more dynamic and relevant methods of implementing restrictions aimed at protecting wildlife.
- Continued to carry out long-term monitoring of key indicators of Glacier Bay marine ecosystem, including oceanography (23 years), humpback whales (31 years), Kittlitz's Murrelets (7 years), and harbor seals (24 years).
- The NPS implemented long-term monitoring of several key vital signs, including Water Quality, Marine Contaminants, Weather and Climate (as well as Oceanography and Kittlitz's Murrelets).
- Collaborated on research projects addressing impacts of climate change on Glacier Bay system with a number of outside institutions, including ocean acidification, glacier status and trends, hydrologic modeling, and availability of ice habitat for harbor seals.
- Started process to restructure commercial charter fishing management to meet resource protection goals.

Cultural Resources

- After years of cooperative planning efforts, the Huna Tribal House (Xunaa Shuká Hít) was completed in 2016, and dedicated in August. The National Park Service continues to work with the tribal government, Hoonah Indian Association, to develop interpretive and operating plans for the facility.
- Over a six-year period, the park collaborated with the tribal government, Hoonah Indian Association (HIA) to design and carve key cultural elements for the Huna Tribal House. The carving project produced a house front, interior house screen, four house posts, and two totem poles. In addition to the production of elaborately carved treasures, the project provided opportunities for the transmission of traditional knowledge related to Northwest Coast arts and fostered a resurgence in cultural pride in the native community of Hoonah.
- Following years of research and collaborative planning, the park completed a Legislative Environmental Impact Statement and published a Record of Decision authorizing the harvest of glaucous-winged gull eggs by HIA tribal members pending required legislation and regulations. Legislation authorizing gull egg harvest was signed in 2014. Tribal members have continued to assist park biologists with research and monitoring efforts.

Visitor Experience

- With a staff of five permanent, one term, and 26 seasonal employees in 2015, the park provided interpretive services and original programs to more than 500,000 visitors on cruise ships, tour vessels, and at Bartlett Cove. Staff also provided educational outreach programs that reached over 4,000 students, both locally and nationally and set in motion interpretive planning for the Tribal House project.
- Approximately 95% of Glacier Bay's visitors arrive on ships and tour boats, and park interpretive staff present meaningful and effective presentations on board an array of vessels (almost 500 vessels in 2015).
- Glacier Bay's Junior and Explorer Ranger programs onboard cruise ships continue to reach thousands of children during the summer months. In 2016, the park emphasized teen programs with a ranger. Throughout the summer, rangers presented 276 Junior Ranger programs to more than 6,700 children and teens.

- Using the park's videoconferencing system, rangers presented a series of long-distance education programs to more than 2,665 students and 324 teachers in 18 different states and 1 Canadian province. The long-distance program received the prestigious Pinnacle Award for the third year in a row from the Center for Interactive Learning and Collaboration based on excellent teacher evaluations of our programs!

Park Infrastructure

- In 2016, the construction of the Xunaa Shuká Hít (Huna Tribal House) was completed. The 2,500 square foot structure will symbolically anchor the Huna Tlingit in Glacier Bay, their ancestral homeland. It serves as a venue for tribal members to reconnect with their traditional homeland, life-ways, and ancestral knowledge; a focal point for conveying the story of the Huna Tlingit, their traditional life-ways, and their evolving relationship with the NPS to the visiting public; and a site for appropriate NPS administrative activities.
- The park has installed an alternate water supply that will better position the park for emergencies and in response to climate change. Instead of relying totally on a surface water source, the park will now be able to use well water.
- The park has nearly completed converting all outboard engines to more efficient 4-cycle engines. This reduces the noise and pollution and improves efficiency over original two-cycle engines on marine vessels.
- Bartlett Cove internet capacity was improved to provide bandwidth for visitor and administrative use.
- The park has added a number of electric vehicles to its fleet to offset the growing need for transportation locally.

Key Issues and Challenges for Consideration in Management Planning

Glacier Bay National Park and Preserve has responsibility for managing natural and cultural resources of national significance to the American people. The unique marine jurisdiction and the nature of its organic legislation built around protecting an ecological process as well as access to the glacier environment provide special challenges. Ten high priority issues have been identified. The issues are listed below in no specific order, and many issues are complex and intertwined.

1. Increased ocean acidification and its effect on marine and terrestrial ecosystems.
2. Private vessel access including access by local communities and tribes.
3. Frontcountry facilities, recreational opportunities, and economic viability of commercial services.
4. Commercial fishing and cooperative fisheries planning with the State of Alaska.
5. Deficiencies in the Glacier Bay park-specific regulations.
6. Lost capability (plane and open ocean capable vessel) to access large parts of the park throughout the year.
7. Securing the successes in changing park and Tlingit tribal relationships.
8. Management of charter and sport fisheries activities.
9. Wilderness planning, wilderness character monitoring, and commercial wilderness services.
10. Preserving the historical legacy of research and promoting the park as a living laboratory.

Chapter 1. Introduction

The purpose of this State of the Park report for Glacier Bay National Park and Preserve (GBNPP) is to assess the overall condition of the park's priority resources and values, to communicate complex park condition information to visitors and the American public in a clear and simple way, and to inform visitors and other stakeholders about stewardship actions being taken by park staff to maintain or improve the condition of priority park resources for future generations. The State of the Park report uses a standardized approach to focus attention on the priority resources and values of the park based on the park's purpose and significance, as described in the park's Foundation Document or General Management Plan. The report:

- Provides to visitors and the American public a snapshot of the status and trend in the condition of a park's priority resources and values.
- Summarizes and communicates complex scientific, scholarly, and park operations factual information and expert opinion using non-technical language and a visual format.
- Highlights park stewardship activities and accomplishments to maintain or improve the state of the park.
- Identifies key issues and challenges facing the park to inform park management planning.

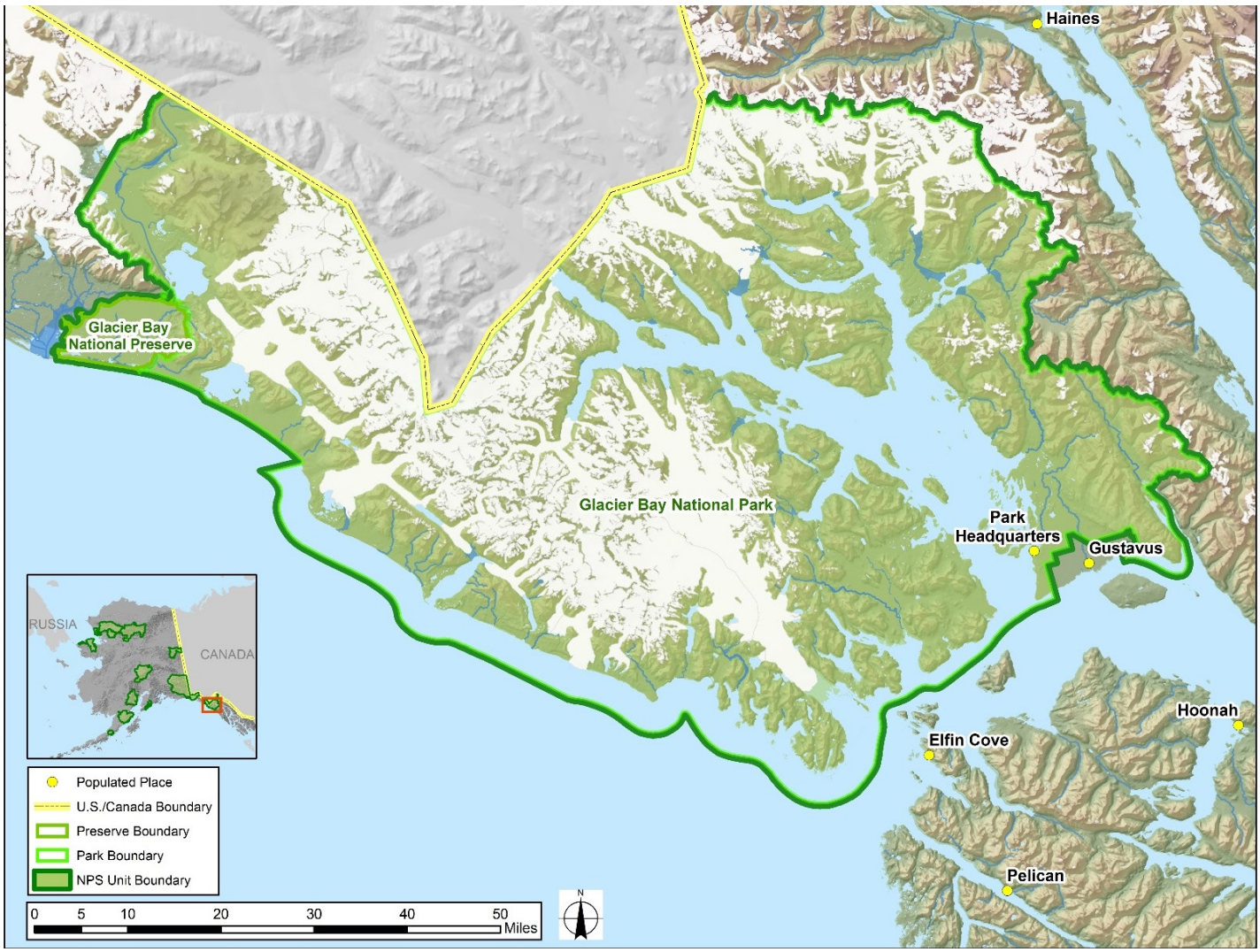
The process of identifying priority park resources by park staff and partners, tracking their condition, organizing and synthesizing data and information, and communicating the results will be closely coordinated with the park planning process, including natural and cultural resource condition assessments and Resource Stewardship Strategy development. The term "priority resources" is used to identify the fundamental and other important resources and values for the park, based on a park's purpose and significance within the National Park System, as documented in the park's foundation document and other planning documents. This report summarizes and communicates the overall condition of priority park resources and values based on the available scientific and scholarly information and expert opinion, irrespective of the ability of the park superintendent or the National Park Service to influence it.

Glacier Bay National Park and Preserve was originally established as a national monument in 1925 and expanded periodically throughout the years. In 1971, Native claims were resolved by passage of the Alaska Native Claims Settlement Act (ANCSA). This act, in addition to Native land claims, also provided for withdrawal of 80 million acres for possible designation as national parks, fish and wildlife refuges, national forests, and wild and scenic rivers. Glacier Bay is among those park areas expanded through Presidential Proclamation in 1978 by President Carter when he withdrew more than 100 million acres of federal land in Alaska. The Alaska National Interest Lands Conservation Act (ANILCA) was adopted on December 2, 1980. This act established most of the national parks in Alaska, expanded the size of Glacier Bay National Park, and created the Glacier Bay National Preserve. The passage of this act culminated more than 20 years of deliberation on federal land claims after Alaska statehood.

ANILCA mandates the specific purposes for each park established. Congress also provided that ANILCA would permit some key activities necessary to perpetuate the rural Alaskan lifestyle, including subsistence uses, traditional uses, access, cabins, and hunting and trapping. Providing for ANILCA's mandates and special uses makes management of Alaska parks unique within the national park system.

The purpose of Glacier Bay National Park and Preserve is to protect a dynamic tidewater glacial landscape and associated natural successional processes for science and discovery in a wilderness setting.

Glacier Bay National Park and Preserve protects over 5,000 square miles of Alaska, with over 4,000 square miles of protected wilderness. Located in southeastern Alaska, between the Gulf of Alaska and Canada, GBNPP includes the St. Elias Mountains, the Fairweather Range, the Brady Icefield, 15 tidewater glaciers, and Glacier Bay itself. Where most National Parks stop at the beach, Glacier Bay National Park preserves nearly 600,000 acres (2,428.1 km^2) of marine ecosystems in Glacier Bay. GBNPP is not connected to the Alaska road system. Access to the nearby town of Gustavus and to park headquarters at Bartlett Cove is by air or by ferry (Alaska Marine Highway). Glacier Bay is a popular cruise ship destination, bringing hundreds of thousands of visitors into the park annually.



Map of the Park

Chapter 2. State of the Park

The State of the Park is summarized below for six categories—Natural Resources, Cultural Resources, Visitor Experience, Park Infrastructure, Wilderness Character, and Subsistence and Commercial Fish Harvest—based on a synthesis of the park's monitoring, evaluation, management, and information programs, and expert opinion. Brief resource summaries are provided below for a selection of the priority resources and values of the park. Clicking on the web ▸ symbol found in the tables and resource briefs below will take you to the internet site that contains content associated with specific topics in the report.

The scientific and scholarly reports, publications, datasets, methodologies, and other information that were used as the basis for the assessments of resource condition are referenced and linked throughout the report and through the internet version of this report that is linked to the NPS IRMA data system (Integrated Resource Management Applications). The internet version of each report provides additional detail and sources of information about the findings summarized in the report, including references, accounts on the origin and quality of the data, and the methods and analytical approaches used in data collection and the assessments of condition. Resource condition assessments reported in this State of the Park report involve expert opinion and the professional judgment of park staff and subject matter experts involved in developing the report. This expert opinion and professional judgment derive from the in-depth knowledge and expertise of park and regional staff gained from their being involved in the day-to-day practice of all aspects of park stewardship and from the professional experience of the participating subject matter experts. This expert opinion and professional judgment utilized available factual information for the analyses and conclusions presented in this report. This State of the Park report was developed in a park-convened workshop.

The status and trends documented in Chapter 2 provide a useful point-in-time baseline measured against reference conditions that represent "healthy" ecosystem parameters, or regulatory standards (such as those related to air or water quality). We also note that climate change adaptation requires us to continue to learn from the past, but attempting to manage for conditions based on our understanding of the historical "natural" range of variation will be increasingly futile in many locations. Thus, these reference conditions, and/or our judgment about resource condition or trend may evolve as the rate of climate change accelerates and we respond to novel conditions. Our management must be even more "forward looking," to anticipate plausible but unprecedented conditions, also recognizing there will be surprises. In this context, we will incorporate climate considerations in our decision processes and management planning as we consider adaptation options that may deviate from traditional practices.

Climate impacts many aspects of park management, from ecological systems to park infrastructure. The climate is changing and human influence is now detectable in nearly all major components of the climate system, including the atmosphere and oceans, snow and ice, and various aspects of the water cycle (IPCC 2013). Global patterns of change demonstrate the human effects on climate are even more pronounced in high latitudes and Polar Regions (Larsen et al. 2014). As a region, Alaska has warmed more than twice as rapidly as the rest of the United States over the past 60 years, with average annual air temperature increasing by 3 °F (1.7 °C) and average winter temperature by 6 °F (3.3 °C) (Chapin et al. 2014). The observed impacts of a warming climate in Alaska include declining sea ice, shrinking glaciers, thawing permafrost, changing ocean temperatures and chemistry, increased coastal erosion, and more extensive insect outbreaks and wildfire (e.g., Larsen et al. 2014, Chapin et al. 2014, Markon et al. 2012).

Even with multiple lines of evidence that Alaska is warming, interpreting trends and other climatic indicators locally is complicated because there are few long-term measurements over a vast geographic region. Alaska's climate is also dynamic with strong linkages to atmospheric and oceanic processes, such as the position of the polar jet stream, the occurrence of equatorial El Niño events and the extent of Arctic sea ice (Papineau 2001, Boisvert and Stroeve 2015).

A climate index of sea surface temperature anomalies, evident in many Alaska long-term climate stations, is the Pacific Decadal Oscillation (PDO). The PDO indicates much of the warming that has occurred since the middle of the 20th century occurred in the late 1970s as a stepwise shift, and is reflected in the PDO climatic transition from a cool to a warm phase (Chapin et al. 2014; Bieniek et al. 2014). In the early 2000s, the PDO shifted back to a cooler phase resulting in statewide temperatures that were cooler than previous decades while still reflecting a long term warming trend (Bieniek et al. 2014). At Glacier Bay, consistent and broadscale measurements of weather have only occurred very recently.

Future climate conditions in Glacier Bay National Park and Preserve are expected to be warmer and drier. Based upon models produced by the Scenarios Network for Alaska and Arctic Planning, overall temperatures are projected to increase at an average rate of ≈1 °F per T decade over the next few decades, with winter temperatures projected to change the most dramatically. Across GBNPP, precipitation is predicted to increase; however, the projected increase in evapotranspiration is expected to outweigh the overall increase in precipitation making the resulting overall conditions drier. The effects of our warming climate and ocean acidification on Alaska park resources can be dramatic. Some of these possible impacts are covered below in the sections on climate change and ocean acidification.

2.1. Natural Resources

Glacier Bay represents a landscape of change. Glaciers have ebbed and flowed in the region for thousands of years. In fact, Glacier Bay National Park was established for the purpose of studying these natural cycles. Scientists regard it as a living laboratory, a place to observe how life returns in the wake of retreating ice. Unlike many park service sites that commemorate a single event or significant features, Glacier Bay celebrates change and natural processes.

There are multiple sources of change that are operating on various spatial and temporal scales. Large scale geologic processes operating on larger spatial and longer temporal scales shape the landscape, including mountain building, glacial recession and isostatic rebound. In addition, active tectonics in southeastern Alaska, as well as the increased thinning of glaciers, are contributing to the extremely high rates of land surface uplift in the region. Smaller scale changes over space and time are manifested in landscape development (erosion, mass wasting, gradual stabilization) and biological succession. In addition to these sources and patterns of change, natural variability (physical and biological) is expected within this young, rapidly changing and developing system.

It is through this lens of a changing landscape that the condition and trend of natural resources must be viewed.

Air Quality

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ozone	Human and Vegetation Health Risks	N/A	Ozone condition status and the risk of ozone injury to vegetation cannot be quantitatively evaluated at Glacier Bay NPP due to the lack of data.
Deposition	Sulfur Wet Deposition		Data from 2010–2014 estimated 1.2 kilograms per hectare per year (kg/ha/yr) of wet sulfur deposition, which equates to an assessment of moderate concern, based upon the NPS Air Resources Division benchmark standards. The degree of confidence in the sulfur deposition status is low because estimated deposition is based on a single monitor approximately 40 kilometers from the park boundary near Juneau, AK. (NADP Monitor ID: AK02). Glacier Bay's remote high-elevation lakes and headwater streams are sensitive to the effects of acidification from atmospheric nitrogen and sulfur deposition (Sullivan et al. 2011a; Sullivan et al. 2011b). Acidification effects can include changes in water and soil chemistry that impact ecosystem health. (Schirokauer et al. 2014). Acidification can also affect the reproduction and survival of fish, invertebrates, and phytoplankton.
	Nitrogen Wet Deposition		Wet nitrogen deposition is in good condition. This status is based on the 2010–2014 estimated 0.6 kilograms per hectare per year (kg/ha/yr) of wet nitrogen deposition and NPS Air Resources Division benchmarks to guide status rating. The degree of confidence in the nitrogen deposition status is low because estimated deposition is based on a single monitor approximately 40 kilometers from the park boundary near Juneau, AK. (NADP Monitor ID: AK02). Ecosystems at Glacier Bay NPP are not typical of nitrogen-sensitive systems and were rated as having low sensitivity to nutrient-enrichment effects. However, the park's alpine and wetland vegetation are vulnerable to excess nitrogen deposition, which can alter plant communities and reduce biodiversity. (Sullivan et al. 2011c; Sullivan et al. 2011d).

Air Quality (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Deposition (continued)	Mercury/Toxics Deposition		Mercury/toxics deposition warrants moderate concern. In-park data (studies and availability of fish consumption guidelines) on mercury and toxics in food webs have been used to quantify this (NPS-ARD 2015). Previous mercury monitoring in the park recorded a relatively low 2010–2013 average annual wet deposition of 2.6 µg/m^2 (NADP-MDN 2015; NADP MDN Monitor ID: AK05). An air sampler near sea level at Glacier Bay detected moderate concentrations of historic-use pesticides and low concentrations of current-use pesticides. Glacier Bay has recorded a higher proportion of some hydrocarbons than other sites in southeast Alaska suggesting a local source (Landers et al. 2008). No trend information is available because there are not sufficient on-site or nearby mercury monitoring data.
Visibility	Haze Index		Visibility condition status and trend cannot be quantitatively evaluated at Glacier Bay NPP due to the lack of local monitoring stations. However, qualitative information suggests that air is clear and visibility is good. While emissions from large cruise ships in Glacier Bay can become trapped by inversions creating haze and affecting visibility, these impacts tend to be temporary, lasting for several hours to a day (Mölders et al. 2013, Pirhalla et al. 2014).

Landscape Features and Processes

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Climate	Air temperature, Precipitation	N/A	Local climate data within the GBNPP region are limited precluding an assessment of condition and trend. In the last year, several weather stations were installed in GBNPP that measure core climate parameters including air temperature, precipitation, wind speed, solar radiation, and relative humidity. Several more stations will be installed in the next few years that will provide data along a gradient of conditions (east/west, north/south, elevation). Projections from Scenarios Network for Alaska and Arctic Planning (SNAP) modeling suggest that future conditions within GBNPP will be warmer with greater precipitation; however, it is expected that when increased evapotranspiration is factored in, conditions overall will be drier. *See Climate resource brief below.*

Landscape Features and Processes (continued)

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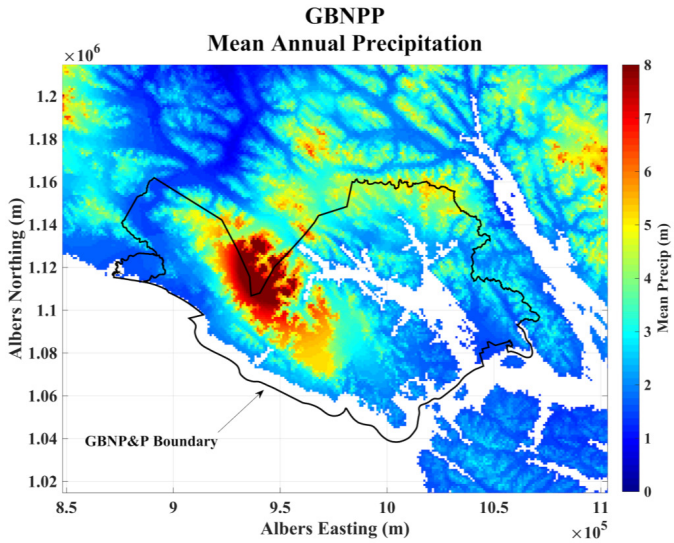
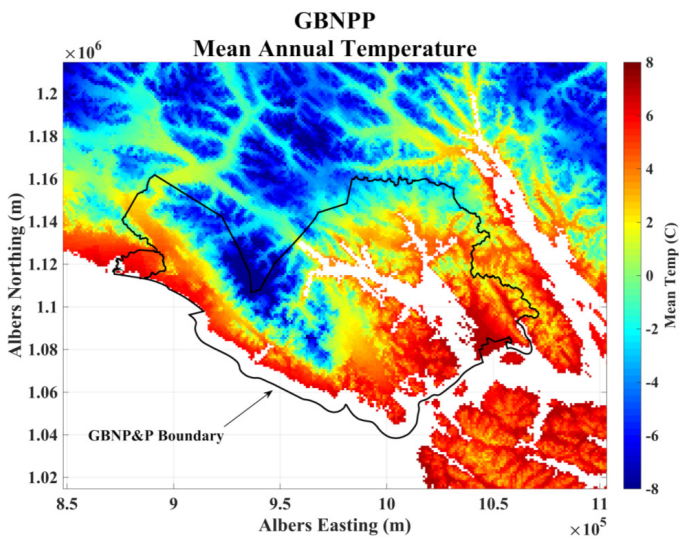
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Glaciers	Glacial Extent and Volume		Glacial extent within GBNPP has decreased by 15% between the early 1950s and 2010. All of the 16 glaciers within GBNPP that underwent surface elevation analysis from 1995 to 2011 showed declines (i.e., thinning) over that time. Mass balance estimates based on surface elevation changes showed that thinning generally ranged from 0.1 to 1.5 m/yr. Only Margerie Glacier experienced increases in surface elevations in some areas, which offset declines in other areas, contributing to a positive mass balance between 2009 and 2011 (Loso et al. 2014). Because glaciers are a signature resource of value to the park, there is significant concern about this downward trend; recent monitoring lends high confidence to the assessment.
Oceanographic Conditions	Temperature, Salinity, Turbidity, Chlorophyll-a, Light penetration, Dissolved oxygen		Core oceanographic parameters have been monitored throughout the water column and at standard stations throughout Glacier Bay proper since 1993. All measures have generally remained within the expected range of seasonal and year-to-year natural variability, and clearly reflect a good and unchanging condition of these indicators collectively (Danielson 2012, Sharman 2013).
Ocean Acidification	pH, Aragonite saturation state		Recent research (Reisdorph and Mathis 2014, 2015) has confirmed that the ocean waters of Glacier Bay proper are acidified (depressed pH and aragonite saturation state), causing significant concern related to the potential to negatively influence the park's marine ecosystem. Low confidence in the trend is assigned because of lack of long-term data and lack of definition of baseline conditions for both Glacier Bay and systems in general.
Vegetation Succession	Plant community succession pattern and process		The most recent in-depth studies of plant successional process and mechanisms in Glacier Bay (Chapin et al. 1994, Fastie 1995) described fully functional developing communities in good condition. Although there has not been any focused plant succession research in the park in several years, there is no reason to believe that this indicator does not remain in good condition.

Resource Brief: Climate



Modeled 30-year mean (1979–2009) annual precipitation for the GBNPP region based on the NASA Modern Era Retrospective Analysis for Research and Applications (MERRA) reanalysis product. The scale is depth in meters and the spatial resolution of the figure is 1km (Beamer et al. 2016).



Modeled 30-year mean (1979–2009) air temperature for the GBNPP region based on the NASA Modern Era Retrospective Analysis for Research and Applications (MERRA) reanalysis product. The scale is in degrees Celsius and the spatial resolution of the figure is 1km (Beamer et al. 2016).

Climate conditions within Glacier Bay National Park and Preserve are influenced by its complex topography and proximity to the Pacific Ocean. There is high spatial variability in precipitation patterns, with the Fairweather Mountains receiving upwards of 1,000 cm of precipitation per year (Davey et al. 2007). Maximum precipitation occurs in the fall (October–November), with driest conditions in late spring. Much of GBNPP experiences relatively mild temperatures, owing to the strong marine influences, with the coldest temperatures found in the Fairweather Mountains.

Future climate conditions in Glacier Bay NPP are expected to be warmer and drier. Based upon models produced by the Scenarios Network for Alaska and Arctic Planning (SNAP), overall temperatures are projected to increase at an average rate of ≈1 °F per decade over the next few decades, with winter temperatures projected to change the most dramatically. Across GBNPP, precipitation is predicted to increase; however, the projected increase in evapotranspiration is expected to outweigh the overall increase in precipitation making the resulting overall conditions drier.

Changes in temperature and precipitation will have a large impact on the glaciers, hydrology, and oceanography as well as the landforms and biological systems of GBNPP. This region is largely defined by water—delivered, transported and residing as humidity, mist, rain, snow, glaciers, icefields, icebergs, rivers, estuaries, and the open ocean. Changes in the amount, timing and form of water delivered to GBNPP will drive both dramatic and subtle patterns and processes in plants, wildlife, and landform.

Three examples of climate change impacts on Glacier Bay National Park and Preserve include documented changes in glaciation, evidence of ocean acidification within Glacier Bay, and projected changes in the hydrology of GBNPP watersheds.

Glaciers

Sensitive to seasonal variation in temperature and precipitation, glaciers are excellent indicators of regional and global climate. Although subject to the same environmental conditions, tidewater glaciers are more complex in their behavior and response to climate change compared to other glacier types.

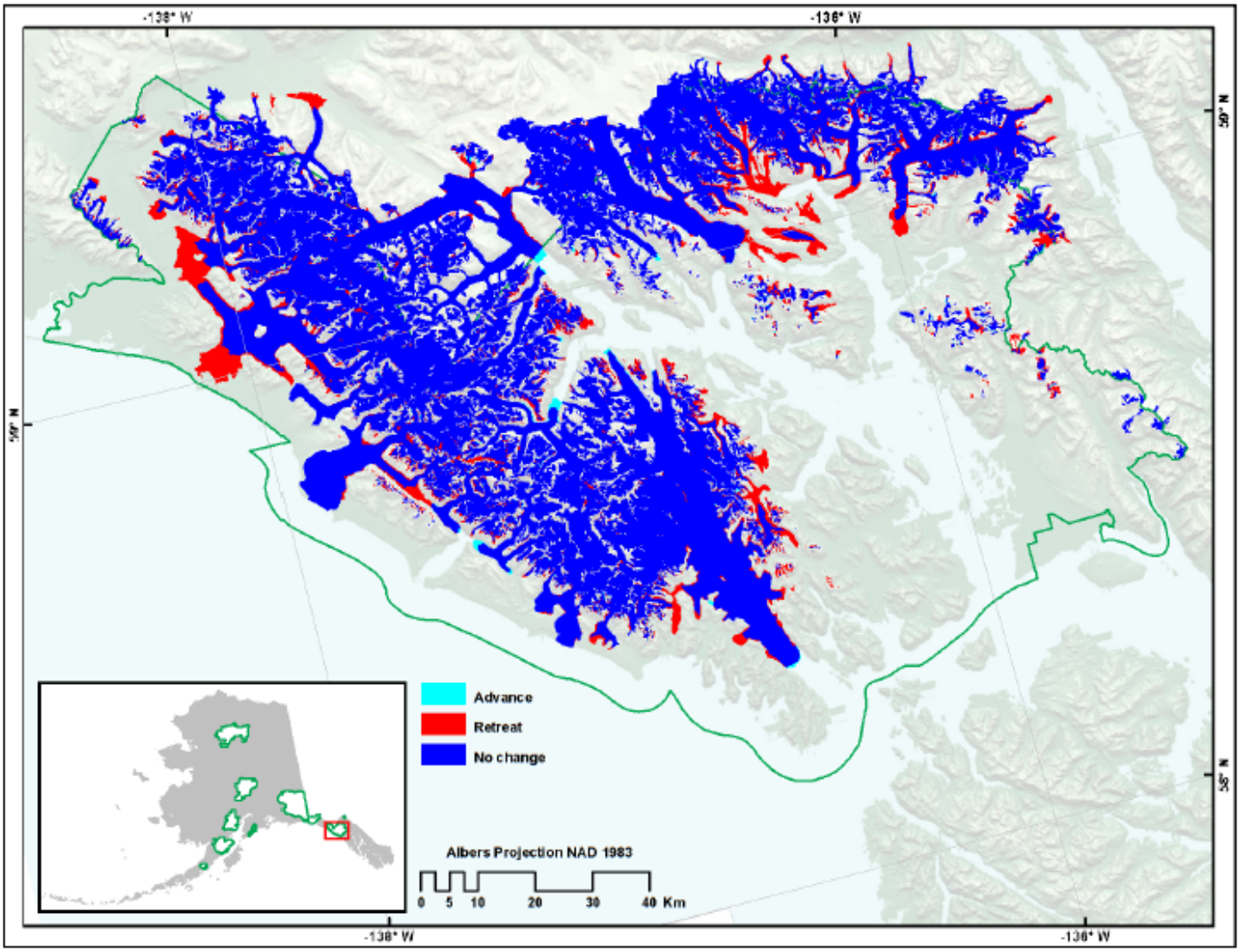
More than 50 glaciers cover 48% of the Glacier Bay's terrestrial area. Glaciers continue to shape the park's dramatic scenery, topography, and landforms while providing billions of gallons of freshwater to a pristine glacial fjord ecosystem. Even seemingly subtle changes in glacial dynamics can have far-reaching consequences, through changes in hydrology and runoff patterns, degree of ocean stratification, carbon delivery, and capacity of the system to buffer against ocean acidification. In coordination with the other Alaska Networks, Southeast Alaska Inventory and Monitoring Program collaborated on a multi-year study of glaciers in Alaskan national parks (Loso et al. 2014).

These recent studies of glacier dynamics (Loso et al. 2014), which included mapping of all glacier extents, measurements of surface elevation changes on select glaciers, and focused research on Brady, Margerie, and Muir Glaciers in GNPP, conclude:

- Ice cover in GBNPP decreased 11% between 1952 and 2010, to become 48.4% glaciated (2,481 mi^2).
- Between 1952 and 2010, the vast majority of glaciers have shrunk considerably, mainly by terminus retreat.

Resource Brief: Climate (continued)

- A few glacier termini advanced in Glacier Bay since 1952. All these advances are by tidewater or recently-tidewater glaciers in retracted positions that may indicate a resumption of normal tidewater glacier expansion.
- Using laser altimetry, researchers measured 32 distinct intervals of elevation change distributed among sixteen glaciers in Glacier Bay between 1995 and 2011. Of these measured intervals, all had negative glacier-wide mass balance rates (overall thinning) with five exceptions: positive rates on Muir Glacier 2005–2009 and 2009–2011 and Margerie Glacier 2005–2009, 2009–2011, and one neutral interval (Lamplugh Glacier 2009–2011).
- The lowest measured balance rate (greatest thinning) was on Grand Pacific Glacier from 2001–2009 with an ice loss average of 1.99 m/yr over the entire glacier surface.



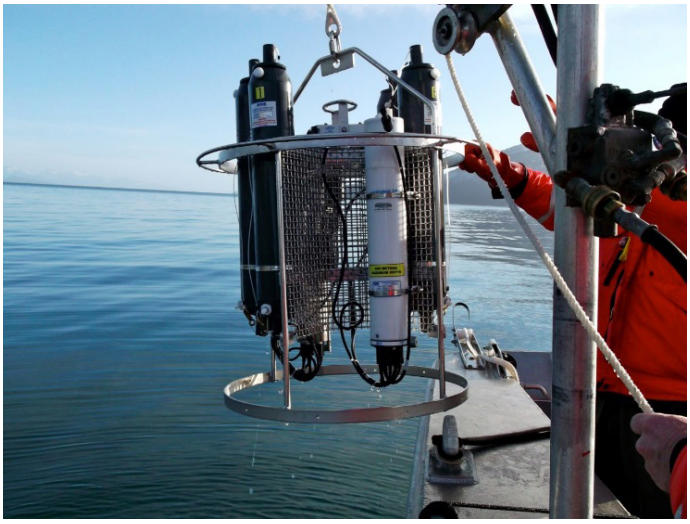
Changes in mapped glacier extent 1952 and 2010 in Glacier Bay (Loso et al. 2014). Dark blue are areas of no change. Red are areas where glaciers have retreated.

Ocean Acidification

Visitors to Glacier Bay journey on marine waters, often with the hope of glimpsing magnificent marine life such as humpback whales. These animals depend on the healthy marine environment protected by Glacier Bay National Park. However, Glacier Bay's waters, like oceans everywhere, are vulnerable to change. Glacier Bay waters are especially sensitive to the phenomenon of ocean acidification—the decrease in the pH of the ocean caused by the absorption of carbon dioxide (CO_2) from the atmosphere. Earth's oceans have always exchanged CO_2 with the air, but today's increasing atmospheric CO_2 levels, largely due to the burning of fossil fuels, mean higher levels of dissolved CO_2 in seawater.

Resource Brief: Climate (continued)

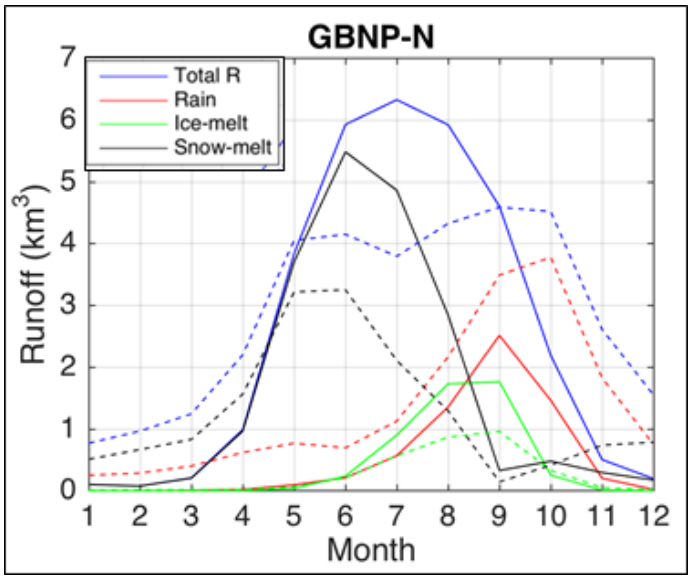
Studies show that even small reductions in ocean pH can be damaging to animals with shells (because the acidic water corrodes or eats away at their protective shell covers) as well as impact organism behavior and development. Young clams, crabs, and fishes grow more slowly when pH levels decline, so their chances of survival decrease. Particularly vulnerable are zooplankton, microscopic animals that are near the base of the marine food web. Marine scientists predict a risk of fundamental changes in entire marine ecosystems due to ocean acidification.



Seawater sampler being brought aboard an NPS research vessel. NPS Photo.

A recent research project in Glacier Bay documented reduced pH in Glacier Bay's ocean waters, meaning higher-pH seawater is becoming more acidic. While the pH of seawater is generally resistant to changes in ocean chemistry, this resistance to acidification is diminished when abundant fresh water "dilutes" ocean water and effectively reduces its buffering capacity. The principal sources of fresh water in Glacier Bay are melting glaciers, thawing snow, and rainfall. This dilution effect strengthens during summer months due to higher glacial and snowpack meltwater runoff. Summer is also the time of greatest ocean productivity, so the impact on marine life increases.

Currently there is no evidence of any direct negative effects of ocean acidification on Glacier Bay's ecosystem. Researchers are continuing to investigate ocean pH in order to increase our understanding of and ability to respond and adapt to this environmental change. The National Park Service cannot directly affect the levels of CO_2 entering Glacier Bay's ocean water and the resulting ocean acidification. However, the park strives to reduce other influences on the marine environment so that Glacier Bay can continue to be one of the healthiest marine areas in the world.



Seasonal hydrographs for historic (1979–2015; solid line) and future (2070–2100; dashed line) conditions. The total runoff (R) is shown as well as its constituent sources of rain, ice-melt, and snow-melt (Hill et al. 2017).

Future hydrology

A recent computer-modeling project indicates that the hydrology of Glacier Bay watersheds could change dramatically over the next century. Changes in climate can influence the overall storage of water in glaciers and snow, timing and amount of melting, as well as the amount of water that is input directly as rainfall and when this occurs within the year. As a result, the overall changes in how much freshwater is in the terrestrial system and how it flows into Glacier Bay (influencing the dynamics of the marine environment) is expected to change in magnitude as well as timing throughout the year. For example, the strong summer peak in freshwater runoff, presently caused by ice-melt, will be reduced (due to less glacier cover) and there will be a greater influence of the late spring snow melt contribution (which will come earlier in the year) and moderately increasing fall rains will lead to extended precipitation peaks later into the year (Hill et al. 2017).

Habitats and Communities

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Forest Communities	Yellow-cedar Distribution, Density, Age structure		Yellow-cedar stands currently are exhibiting no contraction in size or distribution, nor is there reduction in tree density within park stands (all three are occurring farther south). Yellow-cedar has been recently well-studied in the park and region (Oakes et al. 2014, 2015).
	Shore pine Density		Since 2010, as many as 50% of shore pines within park stands have died from foliage disease hypothesized to have been facilitated by spring/summer increases in moisture and temperature associated with climate change (U.S. Forest Service 2015, Mulvey and Cleaver 2014). Mortality appears to be ongoing. Shore pine density in the park has recently been well studied.
	Sitka spruce Mortality Distribution (from spruce bark beetles)		The spruce bark beetle outbreak that began in the early 1980s was a natural event, resulting in areas of heavy Sitka spruce mortality in lower Glacier Bay. The outbreak subsided in the early 2000s, and little if any significant change (additional beetle-caused mortality beyond "normal" low-level background) has occurred since (virtually none since 2010). The result is that the outbreak caused a transition from extensive homogeneous dense stands dominated by even-aged individuals, to stands that are more biologically and structurally complex (Schultz and Hennon 2007). The dynamics of affected Sitka spruce stands have been well studied and monitored since the early 1980s.
Non-Native Plants	Number of species, Distribution		The number of non-native species detected 2004–2012 increased from 14 to 49, but this could well have been due to increased survey effort; similarly, non-native plant distribution broadened as survey effort expanded spatially (Fisk 2011, Dowlatshahi 2013). Based on this uncertainty, the overall trend is unchanging. Moderate concern for native plant communities exists because exotic plants negatively influence natives, and we expect modern humans (aided by anthropogenic climate change) to be the principal vector of spread.
Lichen	Number of species		Based on limited collections from a very small proportion of habitats and a very small proportion of the park area, the park supports a remarkably high species richness (over 900 species), and 44 species are thought to be new to science (Spribille and Fryday 2012, Spribille et al. *in prep.*).

Habitats and Communities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Intertidal and Supratidal Region	Natural physical and biologic processes		The intertidal and immediately adjacent supratidal regions of the marine shoreline receive a very large proportion of the concentrated human use/impacts. This habitat is also one of the most naturally disturbed and dynamic in the park (wavewash, riverine sculpting, isostatic rebound). Shoreline habitats are important to many wildlife species for food, travel, and nesting/resting (birds/pinnipeds). Although the nature and magnitude of anthropogenic change in these habitats are poorly understood, human use of the shoreline has increased substantially in recent years, largely due to increases in shore excursions from tour vessels (Miranda and Sharman 2015, Miranda *in prep.*). Somewhat dated comprehensive biophysical inventory data from this region/habitat (Sharman et al. 2007) indicate process integrity. However, because of the potential for negative impacts of localized increasing human activity on natural processes along portions of the shoreline, there is moderate concern about the condition of these processes. Lack of rigorous data (and reliance on professional judgement) yields low confidence in the condition status.

Resource Brief: Yellow-Cedar Forests

Yellow-cedar, a species of high cultural, economic, and ecologic value, has been dying off in British Columbia and Southeast Alaska since the late 1800s, with increasing rates observed in the latter part of the 20th century. Yellow-cedar decline is an example of the effects of climate change and is caused by the absence of temperature-buffering snowpack, wet soils that reduce canopy structure, and shallow rooting that leads to fine-root freezing. Tree death peaked in the 1970s and 1980s—a period marked by warmer winters, reduced snowpack, and severe temperature fluctuations in the spring.

Fish-eye view up through a conifer canopy dominated by a yellow-cedar tree. NPS Photo.

GBNPP hosts stands near the northern extent of yellow-cedar distribution. An estimated 60,000 acres of yellow-cedar forests occur in the park, mostly along the outer coast. Recent research indicates that so far, the park's yellow-cedar stands are healthy and intact. However, with continued warming, yellow-cedar in the park could be vulnerable to future mortality. Much research on yellow-cedar decline has focused on understanding the causal mechanisms, but a species dieback can have cascading effects on the surrounding forest community. Patterns of succession can indicate the future composition and structure of forests affected and their ability to meet broad goals of biodiversity and other ecosystem services.

As yellow-cedar forests decline, a dynamic overstory and understory response occurs in stages. As mature trees die, understory plants gain access to light and nutrients, and opening of the canopy leads to increased sapling regeneration. Researchers found that at sites south of the park where the most time has passed since the onset of decline, no yellow-cedar saplings (trees <2.0 cm diameter at breast height and >1m tall) were observed (Oakes et al. 2014, 2015). If climate-change-induced mortality begins to affect yellow-cedar in GBNPP, we should expect to see fundamental changes in the composition, structure, and dynamics of forests on the park's outer coast.

Resource Brief: Glacier Bay's Remarkably High Lichen Diversity

Recent research has identified GBNPP as a global hotspot of lichen diversity. A 2011–2012 inventory resulted in the collection of over 4,700 specimens representing 878 lichen species, more than any other park in the U.S., and the third highest number ever recorded (worldwide) in an inventory for areas of comparable size. Many of those species are new to Alaska and North America, and 77 of them (and one genus) are new to science.

A community of lichens on weathered wood

These results emphasize the diversity of habitats and environmental conditions across the park. Lichens have colonized many microhabitats that differ from one another not only structurally, but also in relative age, because glacial retreat throughout much of the park has left behind a landscape "chronosequence" of surfaces of different ages.

The findings are especially significant in light of the fact that vast areas of the park, including many habitat types, remain un-surveyed. The researchers described their survey as "a mere scratch on the surface of what's probably out there." Continuing data analyses will further establish an important baseline for developing hypotheses about species colonization and dispersal in post-glacial ecosystems.

Water Quality

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Riverine Water Quality	Water chemistry parameters		In the Salmon River, near Bartlett Cove, hourly measurements of water temperature, specific conductance, dissolved oxygen, and pH during the ice-free season have remained within a natural range of variability and met Alaska water quality standards. No substantial changes to water quality trends have been observed since 2010 (Sergeant and Johnson 2015).
Freshwater Contaminants	Mercury (Hg)		In 2007, 16 watersheds in or immediately adjacent to GBNPP were surveyed for mercury. Stream water Hg levels were 3–4 orders of magnitude below EPA levels of concern for human health or aquatic organisms. The maximum Hg concentration in juvenile coho salmon from three GBNPP streams was 80 ng/g, which approaches the EPA minimum threshold of 100 ng/g for prey fish. Mercury concentrations tend to rise as watersheds age (Nagorski et al. 2011). In 2012, total Hg concentrations in Dolly Varden from two lakes and one stream in GBNPP (n=15 individuals per site) were variable but averaged 90.2 ng/g, which is slightly higher than the average of fish from 21 western national parks, but similar to other Alaska parks (Eagles-Smith et al. 2014).

Water Quantity (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Freshwater Contaminants (continued)	Methylmercury (MeHg)		In the same 2007 study referenced above, MeHg stayed below concentrations of human health concern in GBNPP streams; concentrations generally increased with watershed age. Peatland-rich older watersheds (> 1,000 years) convert Hg to MeHg and create sources of MeHg to streams (Nagorski et al. 2011; Nagorski et al. 2013; Nagorski et al. 2014). MeHg is easily assimilated by aquatic organisms, and levels may rise in GBNPP as watersheds age.
	Persistent Organic Pollutants (POPs)		In the same 2007 study referenced above, no current-use pesticides have been detected in juvenile coho from 14 GBNPP streams. Some historic use POPs were detected in the same samples, but concentrations were 1–3 orders of magnitude below thresholds of concern for piscivorous wildlife (Nagorski et al. 2011).
Marine Contaminants	Metals		From 2007–2011, arsenic and cadmium concentrations in bay mussels (*Mytilus trossulus*) were < 2 ppm, while mercury concentrations were < 0.03 ppm. These values are low relative to national-scale Mussel Watch data. In 2007, 48 sites throughout Glacier Bay proper and Excursion Inlet were sampled, while in 2009 and 2011, a subset of 5 sites generally following the cruise ship route from lower to upper bay were sampled (Tallmon 2012).
	Persistent Organic Pollutants (POPs)		From 2007–2011, POP concentrations in bay mussels were generally undetectable or near detection limits. PCBs were detectable in many samples, but still very low compared to national averages (Tallmon 2012).
	Polycyclic aromatic hydrocarbons (PAHs)		From 2007–2011, PAH concentrations in bay mussels were generally undetectable or near detection limits. In 2007, the total PAH concentration of a mussel sample from the Bartlett Cove fuel dock was 1,488 ppb, which qualifies as a “medium” level of contamination relative to other national samples. The PAH signal from this sample was consistent with creosote construction. Also, the total PAH concentration from a 2007 Berg Bay sample was 138 ppb and consistent with recent boat usage (Tallmon 2012).

Terrestrial Mammals

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Bears	Distribution and Abundance of black bears		Black bear distribution along the bay has been associated with forest cover; the species is rarely seen in open, recently deglaciated areas (Lewis 2012). As a result, black bears could expand their range north as the landscape in northern Glacier Bay matures from early, open successional stages to closed scrub and forest (Lewis 2012). Recent southward expansion of brown bears, particularly in the Gustavus area, could impact black bear distribution. Little is known about black bear population size in GBNPP. Pinjuv (2013) estimated the total population of black bears on the Gustavus forelands at 54.5 ± 10.3 individuals, or 0.27 bears per km^2, which is lower than densities found in similar terrain in Washington (0.57 bears/forested km^2) (Scott 2011). Mean annual harvest has increased slightly in the Gustavus area (outside park), averaging 3.6 bears annually from 2002–2011 with a maximum of 12 bears in 2002 (Pinjuv 2013).
	Distribution and Abundance of brown bears		Over the past decade, brown bears have expanded their range into the southern portions of the land surrounding Glacier Bay (Lewis 2012). Very little is known about brown bear population size, but numbers in land surrounding northern Glacier Bay are likely relatively low due to limited habitat and salmon resources, whereas numbers along southern Glacier Bay and the outer coast may be higher due to abundant salmon resources (Lewis 2012). Brown bears did not occur around Gustavus until recently and none were harvested in the area until 2012 when a single bear was taken (NPS 2013). Brown bear harvests in the Dry Bay area have increased over time, with a mean annual harvest of 8.3 bears from 2001–2010 (NPS 2013, from Alaska Department of Fish and Game [ADF&G] data).
Moose	Distribution and Abundance		Moose are a relatively new arrival to most of the GBNPP area, first seen in the 1960s. A winter aerial moose survey in 2012 established the current moose distribution for much of the park, documenting moose primarily in coastal areas along Glacier Bay and towards the Gulf of Alaska. Moose are also known to occur in the Dry Bay area, but have not been systematically surveyed there. Moose are most common on the east side of Glacier Bay and may be expanding their range to the west, although steep topography and deep winter snow may limit their distribution in northwestern Glacier Bay (Lewis and White 2016). Moose numbers in the Gustavus Forelands (SE portion of the park) have decreased due to Alaska Department of Fish and Game (ADF&G) management actions in areas bordering the park (Gustavus), through authorized cow hunts from 2002–2006 and 2008 to reduce potential for overgrazing of winter habitat in Gustavus (Scott 2012).

Terrestrial Mammals (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Mountain Goat	Distribution and Abundance		Aerial surveys in 1985 and 2012 reveal mountain goats are distributed evenly across suitable habitat in the eastern and northern region of Glacier Bay and the southern outer coast but more sporadically along the western portion of Glacier Bay (Lewis and White 2015). Distribution surrounding Glacier Bay was similar between the two surveys with the exception of mountain goats sighted on the west side of Tarr and Johns Hopkin Inlets in 2012 and not in 1985, indicating range expansion. Abundance of mountain goats and age ratios decreased (i.e., fewer kids per adult) from 1985 to 2012 in all survey areas that were surveyed in both years and where mountain goats were present (Lewis and White 2015); however, limited data points do not allow for an assessment of potential trend. No sex ratio data were included in the 2012 survey data, so an accurate assessment of sex ratio cannot be completed.

Resource Brief: Bear Genetics

Glacier Bay was covered in ice less than 300 years ago so all the plants and animals present have recolonized since then. How does the length of time since glacial retreat affect the distribution of mammals? What landscape features influence animal migration and the re-colonization of Glacier Bay? Park researchers sought to begin answering these questions specifically for black and brown bears. During the summers of 2009–2010, the distribution of black and brown bears at selected shoreline study sites was determined by direct observation, tracks, and genetic identification of bear hair. Results showed that black bears are closely associated with closed forest cover in the southern 2/3 of the bay and essentially absent from recently de-glaciated (<150 years) habitats. The distribution of black bears will likely move northward as forest develops in newly de-glaciated areas. Brown bears were documented in every study site with highest levels of activity in recently de-glaciated areas of open scrub (<150 years) and old growth forest (>300 years), and lowest levels of activity in the young forest areas of southern Glacier Bay.

A brown bear searches for food on a recently de-glaciated rock face in Johns Hopkins Inlet, Glacier Bay. NPS Photo by Tania Lewis.

Scientist also used the DNA from bear hair to determine the genetic relatedness of bears along the shoreline of the park and the level of mixing that occurs between different geographic areas. Genetic results indicate that brown bears in the upper west arm of Glacier Bay comprise a unique population. The two other populations present in the park are divided neatly into eastern and western groups by the wide mouth of Glacier Bay proper. The same area hosts five distinct populations of black bears, four of which occur only on the east side of Glacier Bay and one of which occurs only on the west side. Glacier Bay fjord appears to inhibit dispersal and funnels recolonizing bears from east and west in a northward direction. With the retreat of glacial ice, brown bears have expanded their range into the northern end of Glacier Bay and are currently coming into secondary contact after hundreds and possibly thousands of years of separation. The range expansion of black bears into the north, however, is likely limited by suitable habitat and possibly by competition with brown bears. Wide fjords such as Glacier Bay and steep glacial covered mountains such as the Fairweather Range block movement and therefore greatly influence how bears and other land mammals recolonize the shoreline of Glacier Bay.

Marine Mammals

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Harbor Seals	Distribution and Relative Abundance at Glacial Ice and Terrestrial Sites		The harbor seal is a pinniped that uses terrestrial and glacier ice habitats in GBNPP for resting, pupping, foraging, and molting (Mathews & Pendleton 2006; Womble et al. 2010; Womble et al. 2014). Harbor seals generally exhibit high fidelity to GBNPP during the pupping and molting periods (May–August) (Blundell et al. 2011). Population monitoring studies of harbor seals in Glacier Bay have spanned from 1970s to the present, representing one of only a few sites in Alaska where such long-term monitoring efforts exist. The largest aggregations of harbor seals in GBNPP occur at the glacier ice site in Johns Hopkins Inlet and at Spider Reef, a terrestrial site in the Beardslee Islands (Mathews & Pendleton 2006; Womble et al. 2010). From 1992–2013, the population trend estimate for non-pup harbor seals at terrestrial sites during the molting period (August) was less negative (-6.91%/yr) (Womble et al. 2015) than previously reported (-12.41%/yr) from 1992–2008 (Womble et al. 2010), suggesting that the number of seals counted at terrestrial sites has increased in recent years. At the primary glacier ice site in Johns Hopkins Inlet, long-term trend estimates (from 1992 to 2008) for non-pups during the pupping period in June (-7.7%/yr) and during the molting period in August (-8.2%/yr) were also negative (Womble et al. 2010). Management concern exists based on long-term declines in the population; however, data from more recent years suggest that the number of harbor seals in Glacier Bay may be increasing. GBNPP uses closures and vessel speed and approach distance restrictions to decrease disturbance to harbor seals at terrestrial and glacier ice habitats.
Humpback Whales	Distribution and Abundance		The humpback whale is a migratory baleen whale that uses GBNPP as a feeding ground spring through fall, first reported in GBNPP in 1899, but not commonly documented in the park until the 1950s. Since the 1970s, researchers have photographically identified individual humpback whales that are long-lived and have strong maternally-directed fidelity to their feeding grounds. The NPS humpback whale monitoring program began in 1985. Humpback whales are found throughout Glacier Bay but tend to be concentrated in high productivity areas in the lower bay dependent on the availability of their main prey: forage fish and krill. Annual variability in numbers occurs when whales shift their feeding areas elsewhere in Southeast Alaska. An overall increasing trend (4.4% annually 1985–2009; Saracco et al. 2013) in Glacier Bay (Neilson et al. 2014, 2015), mirrors population increase in Southeast Alaska and the North Pacific (Straley et al. 2009, Hendrix et al. 2012, Saracco et al. 2013). Whale aggregations in narrow passages and shipping channels create a risk of vessel strikes. GBNPP uses vessel speed and course restrictions authorized by CFR 13.65 to decrease disturbance and collision risk.

Marine Mammals (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Sea Otters	Distribution and Abundance	⇧	Following extirpation from southeastern Alaska by the Russian commercial fur trade prior to 1911, sea otters were reintroduced to southeastern Alaska in the 1960s. Sea otters were first documented at the mouth of Glacier Bay in 1988. Beginning in 1993 the USGS Alaska Science Center initiated a study to quantify the spatial distribution and abundance of sea otters in Glacier Bay using aerial surveys (Esslinger et al. 2015). Abundance estimates of sea otters increased from ≈300 sea otters in 1993 to over 5,000 sea otters in 2012. The rate of population growth was 21.5% (Williams et al. *In review.*). Sea otters are found throughout most of Glacier Bay with the highest densities occurring near Boulder Island, Flapjack Island, Caroline Shoal, and near Ripple Cove. Opportunistic observations from 2014–2016 documented sea otters in Scidmore Bay, Adams Inlet, Tarr Inlet, Muir Inlet, and Russell Passage.
Harbor Porpoise	Distribution and Abundance	⇔	Assessment of harbor porpoise distribution is based on the locations of porpoise sightings in directed and opportunistic marine mammal surveys. Dahlheim and Waite (2006) and Dahlheim et al. (2012, 2015) documented harbor porpoise distribution in GBNPP between 1991 and 2010. Gabriele and Lewis (2000) and Barlow et al. (*in prep.*) opportunistically documented porpoise locations for more than 15 years. Harbor porpoise were sighted throughout the bay from the entrance of the bay to the tide-water glaciers. Distribution was clumped toward the lower bay including Sitakaday Narrows, Fingers Bay and Bartlett Cove although also frequenting the mouth of the East Arm, Adams Inlet, Reid Inlet and Russell Island. The distribution of harbor porpoise is widespread within Glacier Bay and does not appear to be radically changing over time. Harbor porpoise abundance is available from NOAA sighting trackline data and from opportunistic sightings during humpback whale monitoring efforts (Gabriele and Lewis 2000, Barlow et al. *in prep.*). Dahlheim et al. (2012, 2015) estimated a decreasing population trend (-0.9%) over the surveying period. Porpoise density is thought to be dynamic, and the combination of density and abundance here is illustrated by the stable condition trend.

Marine Mammals (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Steller Sea Lions	Distribution and Abundance	⇧	The number of non-pup Steller sea lions counted from aerial photographic surveys in the Glacier Bay region increased by 8.2%/year from the 1970s to 2009. The most rapid growth occurred at South Marble Island (16.6%/yr: 1991–2009). (Mathews et al. 2011). Steller sea lions from both the eastern (delisted in 2013) and western (listed as "Endangered" under the Endangered Species Act) distinct population segments occur in Glacier Bay (Jemison et al. 2013). Graves Rocks transitioned from a haulout (resting place) to a rookery (pupping site) in the late 1990s. Several new haulouts have been documented in recent years in the Glacier Bay/Icy Strait/ Cross Sound at Tarr Inlet, Point Carolus, Gloomy Knob, Middle Pass Rock, Gaff Rock, Black Rock. Seasonal patterns in the distribution of Steller sea lions are influenced by the seasonal availability of prey. During spring large aggregations of Steller sea lions aggregate at the mouth of the Alsek River, Tarr Inlet, Dry Bay, and at Adams Inlet in response to spring-spawning eulachon and other seasonally available prey species. Similarly, sea lions aggregate at Middle Pass Rock and Point Carolus during summer and early fall in response to salmon returning from the Gulf of Alaska to Cross Sound and Icy Strait. (Womble et al. 2005; Willson & Womble 2006; Womble et al. 2009).

Resource Brief: Humpback Whale Population Dynamics

NPS research vessel approaching humpback whales for individual identification. Photo credit Bob Christensen.

Glacier Bay National Park's humpback whale monitoring program is likely the longest running humpback whale photo-identification study in the world. Every year since 1985, humpback whale population characteristics in Glacier Bay and adjacent waters have been monitored to document the number of individuals, their spatial and temporal distribution, calf production, genetics, feeding behavior, and human/whale interactions including strandings, entanglements in fishing gear, and behavioral disturbance.

The primary objective of this research is to detect changes in whale abundance, distribution, and population parameters. The resulting information is used to determine where and when vessel operating restrictions are needed to protect humpback whales, an endangered species. To mitigate whale disturbance by vessels, the NPS limits the number of vessels in Glacier Bay, prohibits vessels from approaching whales, and applies vessel course and speed restrictions in areas where whales congregate to feed.

These whales utilize many of the same resources as other marine mammals and many seabirds, making them good indicators of the health of the marine food web. Our continued monitoring of the whale population, oceanography and prey availability will improve our understanding of important changes occurring in the dynamic Glacier Bay ecosystem.

Resource Brief: Harbor Seal Ice Availability

Tidewater glaciers calve icebergs into the marine environment, which then serve as pupping and molting habitat for some of the largest seasonal aggregations of harbor seals in Alaska. Although tidewater glaciers are naturally dynamic, advancing and retreating in response to local climatic and fjord conditions, most of the ice sheets that feed tidewater glaciers in Alaska are thinning and, as a result, many of the tidewater glaciers are retreating. Climate change models predict rapid loss of glacial ice with unknown impacts to seals that rely on tidewater glacial habitat. Glacier Bay NPP and the National Park Service Coastal Cluster Program, in partnership with the University of Alaska Fairbanks – Geophysical Institute and the National Marine Mammal Laboratory – Polar Ecosystem Program, are currently working on a project that uses aerial digital imagery, remote sensing technology, and geospatial models to assess seasonal and annual changes in the availability and characteristics of glacial ice as habitat for seals in Johns Hopkins Inlet, a tidewater glacier fjord in Glacier Bay National Park.

Systematic aerial photographic surveys are conducted of seals and ice during the pupping (June) and molting (August) seasons. Surveys are flown along a grid of 12 transects and high-resolution digital photos are taken directly under the plane using a vertically aimed camera. Seals are mapped in GIS and spatial statistical models are used to create an intensity surface from mapped seal densities. Object-based image analysis is used to quantify iceberg size, % ice cover, and % open water in the fjord (McNabb et al. 2016). Harbor seals exhibit high seasonal fidelity to tidewater glacial fjords during the pupping and molting seasons, thus understanding relationships between glacial ice dynamics and harbor seal distribution and abundance will be critical for understanding how future changes in tidewater glaciers may impact harbor seals.

Aerial view of Harbor seals resting on glacier ice in Johns Hopkins Inlet in Glacier Bay National Park. NPS Photo.

Birds

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Murrelets (Kittlitz's and Marbled)	Abundance		Murrelets are ocean foragers that depend on abundant forage fishes and to some extent recently deglaciated habitat for successful summertime breeding. Their population dynamics are linked to variation in GBNPP marine and terrestrial ecosystems. From 2009–2016, the estimated July abundance of Kittlitz's murrelets in Glacier Bay proper has ranged from 7,025 to 16,469. Marbled murrelets have ranged from 28,978 to 84,428. This abundance constitutes a significant portion of the global populations for these species (Sergeant et al. 2017; USFWS 2013). While the specific mechanisms most greatly influencing abundance estimate remain unknown, the estimate ranges likely reflect a combination of survey method bias and varying movement patterns of murrelets related to breeding, foraging, and migration.

Birds (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Breeding Landbirds	Species Richness and Diversity		Saracco and Gende (2004) sampled both coniferous and deciduous forests of eastern and western GBNPP and recorded 31 species. There do not appear to be major concerns in GBNPP regarding the current species richness of breeding landbirds. However, the most recent data source is >10 years old, and may no longer be indicative of the current species richness for the park. No study in GBNPP has specifically reported on species diversity. Diversity in the park is likely influenced by habitat type, as breeding landbirds in the park appear to have higher species richness and abundance in habitats that are earlier deciduous habitats (Saracco and Gende 2004).
Glaucous-winged Gulls	Distribution and Abundance		Glaucous-winged gulls have generally occupied the same nesting islands in GBNPP for several decades. However, some historic nesting sites have been vacated (e.g., North Marble Island) due to habitat changes. Six of the largest glaucous-winged gull nesting colonies have been monitored yearly from 2012–2015 (Lewis et al. *in prep.*). With the exception of South Marble Island, the mean number of nests observed from 2012–2015 at each colony was significantly higher or similar to those observed in single surveys taking place between 2003 and 2005 (Arimitsu et al. 2007).

Resource Brief: Kittlitz's Murrelets

A Kittlitz's murrelet in Glacier Bay; NPS Photo by Richard Nelson

Annual monitoring of Kittlitz's murrelet (KIMU) abundance by the NPS confirms that Glacier Bay supports a large proportion of the global KIMU population every summer. In 2013, the U.S. Fish and Wildlife Service estimated the minimum global KIMU population at over 33,000 birds. Although abundance estimates are highly variable between years, Glacier Bay may support approximately one-third of the global population during the summertime. While KIMU are no longer a candidate species for listing by the Endangered Species Act, they remain a priority conservation concern for the Pacific Seabird Group, who recently advocated for continued, long-term research and monitoring. The NPS Southeast Alaska Network murrelet monitoring program has been in place since 2009 and is currently the only existing long-term KIMU monitoring program in the world.

KIMU may serve as an important indicator of terrestrial and marine ecosystem health within Glacier Bay. KIMU breed on bare, rocky ground, which is often associated with areas where glaciers have recently retreated. According to the U.S. Fish and Wildlife Service, approximately 66% of the global KIMU population is associated with glacially influenced landscapes, which are subject to climate change-induced stressors.

Additional research is needed to better understand the connection between glacial habitat changes and KIMU population dynamics. Scientists have estimated that KIMU must eat 75% of their mass each day to survive. As open ocean predators relying on marine fish such as herring and sand lance, healthy KIMU populations may indicate a productive marine ecosystem. Continued monitoring of KIMU, climate, and glacial extent will evolve our understanding of important changes occurring in the dynamic Glacier Bay ecosystem.

Amphibians, Marine Fishes and Invertebrates

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Western Toad	Distribution and Abundance		Limited anecdotal sightings of western toads (140+ observations) throughout the park and Gustavus area suggest that the population has likely declined over the past 30 years. Chytrid fungus, a lethal disease linked to amphibian population declines around the globe (Weldon et al. 2004, Kriger 2006, Hossack et al. 2009), was confirmed in 5 of 18 toads from Gustavus and Glacier Bay Proper during 2007 and 2008. Natural isostatic uplift rates of up to 30 mm/y (Larson et al. 2005) and corresponding wetland drying is likely affecting habitat quantity and quality. Moreover, climate change effects on temperature and moisture patterns could cause further physiological stress, impact habitat quantity and quality, and affect productivity, distribution, and abundance (Ovaska 1997, Donnelly and Crump 1998, Blaustein et al. 2001).
Pacific Salmon	Escapement and Distribution		Some insight into salmon stock health in unmonitored, presumably lightly harvested stream systems can be gained by examining two well-monitored commercially harvested systems. Peak escapement in two terminally harvested systems (East Alsek River sockeye and Excursion River chum has generally remained above 10,000 and 4,000 fish, respectively, although these numbers are reduced from 1970s and 80s historical peaks of around 70,000 fish in each system (Clark et al. 2003, Eggers and Heinl 2008, Heinl et al. 2011). Despite natural isostatic uplift (Faber 2008, Larson et al. 2005) and human caused environmental change (Shanley et al. 2014), these fisheries remain viable, suggesting a similar or better prognosis for more lightly harvested unmonitored systems. Some distribution but very limited abundance information exists for salmonids within three quarters of the 300 plus park streams for which an estimated 74% of these contain anadromous fish. While coho and pink salmon are virtually ubiquitous, chum and especially sockeye salmon are more sparsely distributed. Only three Chinook spawning populations are currently known within the park. One invasive Atlantic salmon was harvested from the Doame River in 2000. Larger more complex stream systems exhibit greater species diversity and higher spawner returns than smaller systems. The quality and quantity of spawning and rearing habitat is thought to be declining as a consequence of uplift (Faber 2008, NPS unpublished data). However, salmon continue to colonize recently deglaciated streams in the upper east and west arms of the bay.

Amphibians, Marine Fishes and Invertebrates (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Pacific Halibut	Stock Status and Harvest	⇩	Pacific halibut are a mixed coastwide (CA to Bering Sea distribution) population with an estimated female spawning stock biomass of around 200 M lbs. (Stewart et al. 2015). Two long-term models estimate current halibut stock at 54% or 39% of the unfished (pre-fishery) population. Stock abundance and size at age had been declining from the late 1990s to around 2010 when these parameters stabilized. The current coastwide exploitable biomass of 185 M lbs. in 2016 is only 25% of the 1997 estimate of 718 M lbs. Recent International Pacific Halibut Commission (IPHC) stock projections suggest stable or increasing (depending on approved, targeted and achieved harvest amounts) halibut biomass and stabilization of the fish size at age decline. Combined recreational and commercial harvest removals currently approach just under a million pounds annually for all of GBNPP and adjoining (non-park) Cross Sound and Icy Strait waters (2003–2013 IPHC and ADF&G data), which is down more than 50% from an estimated 2.3 M lbs. in 1997. Glacier Bay proper accounts for approximately 15% of this total annually on average, where recreational harvest for the first time ever, exceeded the commercial harvest in 2013 by 20,000 lbs. (i.e., 97,700 vs. 76,400 lbs.). Past declines in stock abundance, size at age, anecdotal reports of local depletion and environmental change have all been cause for concern.
Rockfish	Stock Status and Harvest	⇩	Rockfish are slow growing, long lived (to 100+ years), sensitive to overharvest, and rebuild slowly when driven to low population levels. Over 30 species are taken commercially in directed fisheries using troll and longline gear. Rockfish are often taken in higher numbers as bycatch in other commercial fisheries. They are also harvested in personal use and recreational hook and line fisheries. Yelloweye rockfish comprise 90% of all Demersal Shelf Rockfish (DSR) Southeast AK landings (NPFMC 2013). Declining DSR abundance despite a 2% harvest mortality rate target is concerning (Green et al. 2014). A low northern southeast outside waters (NSEO) yelloweye density of 765 fish/km^2 in 1994 merited closure (Green et al. 2014). No stock assessment for northern southeast inside waters (NSEI-Cross Sound and Icy Strait) exists despite a 55,125 lbs. historical harvest based threshold. Average annual Southeast DSR directed and total harvest (directed harvest plus bycatch) has declined 75% & 46%, respectively, during the 2005–2014 period (Green et al. 2014). The directed black rockfish (primary Pelagic Shelf Rockfish indicator) fishery is managed using Guideline Harvest Levels (GHLs), vessel and gear restrictions and area closures (Green et al. 2014) with no stock assessment since 2002. Excluding bycatch, NSEI is closed to black rockfish harvest. Recent (2005–2014) annual average directed black rockfish harvest for southern southeast outside waters (SSEO; outside GBNPP) is much less compared with the 1999–2004 period (4,300 vs. 46,800 pounds). (continued on next page)

Amphibians, Marine Fishes and Invertebrates (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Rockfish (continued)	Stock Status and Harvest (continued)	(continued)	(continued) Slope rockfish stock status is not currently assessed. Average annual slope rockfish harvest (directed and bycatch) in SSEO declined from 521,900 lbs. in 1995–2004 to 207,700 lbs. in 2005–2014.
Small Schooling Fish and Zooplankton	Distribution and Abundance		Small-schooling fish and zooplankton were surveyed (1999–2000) by the USGS. Forage biomass was concentrated in shallow nearshore waters: 50% of acoustic biomass was found at depths < 35 meters, 80% of biomass was found at depths < 80 meters. Some of the highest abundances of zooplankton and small-schooling fish were found in close proximity to tidewater glaciers in the upper East and West Arms as well as in the upper-inlets. Acoustically determined forage biomass was concentrated at Point Adolphus, Berg Bay, along the Geikie-Scidmore shelf, around the Beardslee and Marble Islands, and in the upper arms of Glacier Bay. Walleye, Pollock, and capelin were the most abundant fish species in Glacier Bay. Capelin predominated in the East Arm and walleye pollock was most common in the West Arm. Copepods were the dominant zooplankton taxa in Glacier Bay and followed a general pattern of increasing density and decreasing diversity with distance from the mouth of Glacier Bay (Robards et al. 2003). Spawning areas for capelin and eulachon occur in Glacier Bay proper and along the outer coast (Arimitsu et al. 2007; Womble et al. 2005).
Weathervane Scallop	Stock Status and Harvest		Fisheries District 16 extends from Cape Spencer to Cape Fairweather to the limit of the Exclusive Economic Zone 200 miles offshore. Some unknown portion of the annual District 16 “meats only” dredge fishery harvest (2005–2014 annual average =12,400 lb., range 200–25,500 lbs.; NPFMC 2015) comes from two scallop beds that lie either partially or entirely within the park near Lituya Bay out to 3 miles offshore. Harvest, dredge effort and harvest rate (lbs. shucked meats per dredge hour) for District 16 over the most recent decade have all declined by a quarter to nearly half of the historical average compared with the previous decade (1995–2004). Harvest amount, fishing effort and harvest rate for District 16 during 2013/14 all fell near the middle to lower end of the scale relative to eight other harvested areas statewide (NPFMC 2015). The use of fishery dependent data (i.e., harvest rate) may constitute an unreliable index of scallop abundance, especially for an area exhibiting highly variable effort and meat quality. Declining harvest rates and a recent shell height size-range reduction to one of the lowest in the past ten seasons (NPFMC 2015) emphasize the need for continued on-board observer monitoring and conservative management.

Amphibians, Marine Fishes and Invertebrates (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Tanner Crab	Stock Status and Harvest	⇩	Southeast Alaska Tanner crab stock biomass has declined to 42% of the long-term average, and park trends parallel this region-wide pattern. More recent (2010 & 2011) mature biomass estimates indicate further declines of 20–60% from earlier 1993–2002 levels (Bishop et al. 2013). As of 2011, legal Tanner crab biomass had been increasing in Excursion Inlet since 2007 and Glacier Bay appeared to be increasing from a recent (2010) low. Bitter Crab Syndrome (BCS) is an increasingly prevalent, lethal parasitic dinoflagellate disease spread by past human activities involving crab transport and discard (Meyers et al. 1990). Increased BCS incidence over the last two or more decades may be contributing to stock declines in some areas (Bishop et al. 2013) despite State of Alaska regulations designed to minimize the spread and incidence. Commercial Tanner crab fisheries annually removed an average of 86,500 lbs. from Glacier Bay Proper and 27,400 lbs. from Excursion Inlet over the 2005/06–2014/15 period. This represents a 40% decline in both areas from average annual harvest amounts removed during the previous decade (1995/96–2004/05). Harvest from park waters in Excursion Inlet is unknown due to the mid-channel NPS boundary. Some presumed small but unknown additional harvest also occurs in Icy Passage. Despite a presumed recent increase in legal biomass of park stocks, increasing incidence of BCS and environmental change (especially increased temperature at depth) are continuing concerns affecting Southeast Tanner crab (Bishop et al. 2013).

Resource Brief: Bartlett River Salmon Escapement

Upstream view of the Bartlett River fish diversion fence and DIDSON sonar installation site. NPS Photo.

Pacific salmon are important seasonal ecosystem components in both marine and freshwater systems. Their spawned out carcasses contribute marine derived nutrients to both freshwater and terrestrial ecosystems and they are important predator and prey components to a variety of food webs. A few select species are targeted recreationally by park visitors, and the fishing efforts targeting returning Bartlett River coho salmon has increased since the mid-1990s (NPS unpublished data).

Park fishery staff completed the final of three seasons of fieldwork to estimate coho salmon abundance and harvest in the Bartlett River during 2014. The objective of the project is to provide a baseline against which future change in Bartlett River coho salmon spawner abundance and harvest can be compared. Accurate escapement and harvest estimates for Bartlett River coho salmon will ensure sustainable fishery harvest given likely increasing future fishing effort and changing habitat conditions.

The project involved installation of a Dual frequency IDentification SONar (DIDSON) each year from August through October. The DIDSON works similarly to fish and depth finders. It produces near video quality imagery of migrating salmon and provides the ideal solution for counting fish in a river system where turbid water quality and low light conditions obscure visibility. Fuel cells are clean and quiet power options are available on instrument installations within designated wilderness.

The sonar unit was submerged near the riverbank and aimed across the Bartlett River perpendicular to the water's flow. Diversion fences directed fish through the sonar's field of view. Fish were imaged as they passed through the sonar field and are counted and sized from recorded digital imagery. Anglers were also surveyed each year to estimate fishing effort and coho harvest.

Results from 2012 indicate that 6,952 coho passed the sonar while only 11–228 (95% C.I.) were harvested (< 5%) by anglers. Harvest in 2013 ranged from 466–1,584 (95% C.I.) coho, while coho escapement was an estimated 8,591–13,391 (95% C.I.). Counting of 2014 imagery was recently completed and preliminary analysis indicates between 5,825 and 11,921 (95% C.I.) coho migrated upstream. 2014 harvest was also less than 5% of the estimated escapement. Recording fish passage around the clock for two months each season generated nearly three terabytes of data over each of the three years.

Resource Brief: Halibut Movement

Considering their renown in the Alaska angling world, their stature at the dinner table and their importance in the marine ecosystem, it is surprising how little is known about Glacier Bay halibut movement. Halibut are seasoned travelers during early life history as pelagic larvae. Females release millions of eggs at great ocean depths along the continental shelf during winter. Pelagic larvae travel thousands of miles on ocean currents for up to six months before they settle on the bottom in shallow water and move progressively into deeper waters as they develop. Foot-long halibut are three years old or less, though adults can be nine feet long, weigh over 500 pounds, and live 55 years.

University of AK researchers assess a freshly deployed satellite transmitter tag and post handling condition of a 4-foot-long female halibut. NPS Photo.

Wide ranging movement appears decidedly less common for adult Glacier Bay halibut. University of Alaska researchers tagged twenty-five 3.5 to 5.5-foot-long, female halibut during summer of 2013 to better understand halibut reproductive movement patterns. Satellite transmitter tags recorded depth, temperature, light and magnetic field (to estimate geographic location) and were automatically released from fish after 7 or 12 months. Tags then transmitted recorded information to researchers via satellite. Four tags failed or were lost, but 21 tags provided a wealth of information. Study results contradict the assumption that all adult Glacier Bay halibut migrate to Gulf of Alaska spawning grounds each winter. Instead, the majority (15 of 21) of fish stayed within the Bay, maintaining site fidelity throughout the year. Six fish likely left the Bay near the end of December to spawn, but four of these fish likely returned by mid-March. Depth data confirmed diagnostic spawning rises during January for two of these fish.

Halibut fishing is a major Southeast Alaska industry; area recreational and commercial fisheries harvest five million pounds annually. NPS 1999 regulations established a Glacier Bay proper commercial fishery phase out, which will lead to the cessation of commercial fishing sometime around 2050. Tagging results indicate that halibut spend over 90% of their time in Glacier Bay and almost all of the time spent outside the bay during presumed spawning migrations occurred during the winter commercial fishery closure. These findings suggest there will be increased protection for halibut within Glacier Bay as commercial fishing ends. Continued research in this unique marine ecosystem highlights Glacier Bay's role as a nationally designated marine protected area.

Dark Night Sky

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Anthropogenic Light	Anthropogenic Light		A photic environment is described as the physical amount and character of light at a particular location, irrespective of human perception. The NPS Night Sky Program characterizes a park's photic environment by measuring both anthropogenic and natural light. While no ground-based or modeled data are available for Glacier Bay National Park and Preserve, 2012 visible infrared imaging radiometer (VIIRS) satellite data, which uses a broadband imaging detector with high sensitivity, indicates that there is no visible upward radiance within the park boundary. The most significant sources of upward radiance in the region originate from Juneau, AK and Whitehorse Canada.

Acoustic Environment

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Atmospheric Soundscape	Acoustic Impact Level: A modeled measure of the noise (in dBA) contributed to the acoustic environment by man-made sources		All physical sound resources, whether we hear them or not, are referred to as the acoustic environment of a park. The condition of the acoustic environment is assessed by determining how much noise man-made sources contribute to the existing acoustic environment through the use of a national noise pollution model. The mean acoustic impact level averaged across the park is 0.8 dBA, and the acoustic environment is generally quiet, and in good condition (Mennitt et al. 2014).
Underwater Soundscape	Natural ambient sound levels		A hydrophone system in lower Glacier Bay since May 2000 acquires an hourly 30-sec audio sample to characterize the underwater sound environment. The resulting data show that vessel noise strongly influences the underwater acoustic environment of lower GBNP with a strong seasonal and diurnal pattern. The occurrence of vessel noise in audio samples increased significantly from 59% in 2000–01 to 66% in 2007–08, corresponding with the vessel quota increase in 2007 (McKenna et al. 2017). Vessel quotas have not undergone further increase to date. The durations of vessel-noise-free intervals are currently unknown. Innumerable marine organisms utilize the underwater sound environment, and its integrity is vital to ecosystem health. For example, vessel noise causes marine mammal disturbance and limits their ability to communicate and detect environmental cues including predators and prey. Sophisticated modeling techniques (after Clark et al. 2009, Hatch et al. 2012) of marine mammal communication space (CS) relative to the communication space under naturally quiet conditions indicated that the CS available to contact-calling humpback whales was reduced by 80–96% in typical summer traffic conditions, even in the absence of cruise ships. Harbor seal roars, a male mating display, lost 60–80% of CS in typical summer vessel noise (Gabriele et al. *in prep.*). (continued on next page)

Acoustic Environment (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Underwater Soundscape (continued)	Natural ambient sound levels (continued)	(continued)	(continued) Regulatory limits on vessel traffic are the main method for limiting underwater noise. Vessel numbers, types, scheduling and routes affect the amount and characteristics of vessel noise. Slower vessel speed regulations reduced average noise levels (10–15 dB) of large vessels.

Resource Brief: Acoustic Environment Above and Below

An important part of the NPS mission is to preserve or restore the natural soundscapes of parks and provide for enjoyable visitor experiences. As a large wilderness park encompassing one of the largest (nearly 600,000 acres) federally protected marine ecosystems in Alaska and more than 2.7 million acres of wilderness, GBNPP includes substantial areas of airborne and underwater soundscapes, offering a diverse array of natural sounds and an environment relatively free of human-caused sound. The acoustic environment is an integral component of what makes Glacier Bay a globally significant marine and terrestrial wilderness offering human solitude that is rapidly disappearing in today's world as well as relatively undisturbed acoustic habitats for animals that rely on sound for basic life functions such as feeding, detecting predators and maintaining social bonds.

Natural soundscapes with an absence of human-caused sound are reduced by park visitation via motorized vessels and aircraft, which introduces a significant amount of anthropogenic noise into the ecosystem. The addition of noise to the park's acoustic environment is a concern for terrestrial and marine wildlife and preservation of wilderness character. Ongoing efforts to characterize sound environments in air and underwater will inform park managers on how to minimize sound disturbance to humans and animals alike.

Richard Nelson uses a parabolic microphone to record the sounds made by glaciers, as part of the Sound Library Project completed in 2014. NPS Photo by Hank Lentfer.

Up In the Air – Since 2000, park biologists have worked with scientists at the NPS Natural Sounds and Night Skies Division to monitor airborne soundscapes in the Park, primarily a single recording station near Park Headquarters at Bartlett Cove designed to characterize the arrival of migratory birds in the spring and early summer.

A two-year effort to create a Natural Sound Library in collaboration with University of Alaska researchers resulted in a collection of 634 individual tracks representing 90 bird species and 14 mammals. Digital copies of all tracks are archived at GBNPP as well as the Natural Sounds Library at the Cornell Laboratory of Ornithology and the Alaska Coastal Rainforest Center.

Under the Sea – Since 2000, park biologists have collaborated with acousticians at the U.S. Navy in an effort to understand more about Glacier Bay's underwater sound environment. This research has led to discoveries about contact calling between humpback whales and about mating "roars" made by male harbor seals.

A hydrophone near the entrance to Bartlett Cove transmits underwater sounds through a 5-mile cable to a computer workstation that takes a sound sample every hour for 30 seconds. This study has produced Glacier Bay's first quantitative descriptions of "natural underwater sounds" such as wind, rain, and animal vocalizations and helped increase understanding of the effects of different numbers of vessels, types of vessels, and vessel speeds on the underwater "soundscape" of Glacier Bay. The work has characterized the noise from individual vessels and shown that the underwater noise environment in Glacier Bay was substantially quieter when vessels were required to travel at 10 knots rather than at 20 knots.

In collaboration with the Bioacoustics Research Program at Cornell University and Marine Acoustics Incorporated, sophisticated computer models are being used to simulate whale and vessel movement through time and space to estimate acoustic habitat loss for humpback whales (and harbor seals) under various conditions.

Scientific Research

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Maintaining Glacier Bay as a Living Laboratory for Research	Number of scientific investigators with research permits; Satisfaction of researchers with research experience; Number of research partnerships		The park continues to serve as an important natural and dynamic venue for scientific research. In 2015 there were 21 permitted research projects actively operating in the park (compared to 23 in 2014, 21 in 2013, 18 in 2012, and 19 in 2011). In general, about 70% of permits during this period were held by non-NPS principal investigators (universities, other public agencies, non-governmental), and almost all of those projects included some substantial NPS involvement (support in the forms of funding, logistics, and/or personnel). Moreover, many of the remaining 30% of permits where NPS personnel were the principal investigators were for projects that included active external partners. With few exceptions, researchers were satisfied with their research experience in the park.
Using Research Results to Make Management Decisions	Satisfaction of park leadership team with the utility of research for decision-making and adaptive management		The park leadership team regularly uses research information to assist with evaluating management options (e.g., vessel operating restrictions, tour vessel drop-off locations, area closures to protect wildlife, cruise ship quotas, tour vessel contract provisions to protect wilderness character). However, managers are concerned by a lack of a resource stewardship plan and concerns about several strategically important decisions areas in the future (e.g., vessel management, closures to protect wildlife, social impacts in wilderness, and commercial services).

Resource Brief: A Legacy of Research

GBNPP is one of only a few NPS units whose establishing Proclamation/legislation makes explicit reference to providing for scientific research. Consequently, GBNPP has always considered science to be a core part of its management mandate, and attracting quality research—both applied and basic—has been a priority.

Since its initial establishment in 1925, for which the Ecological Society of America lobbied heavily, the park has hosted hundreds of important research projects by dozens of universities and institutions. Several project areas have grown and developed organically as a result of generational "passing on" of lines of study from professor to faculty-bound graduate student, thence to her/his own students, and so on in an almost familial fashion. In addition, several long-term and very valuable projects (plant and stream succession, glaciology, humpback whales, harbor seals, oceanography) have been nurtured and carried on as a result of the park's research priority.

William O. Field prepares to survey and photograph a tidewater glacier terminus ca. 1930. NPS Photo.

GBNPP was established in large part for its opportunities to conduct scientific research. As a true "park for science," GBNPP continues to consider research as one of its primary purposes, and in turn utilizes research results to inform management decision making.

2.2. Cultural Resources

Archeological Resources

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park's archeological resources to the historic contexts for the park.		Three systematic Section 110 park wide survey projects, spanning the total of eight field seasons, have been conducted in GBNPP over the past 51 years, culminating in the recordation of 146 sites and 5,300 acres surveyed. The third comprehensive survey was conducted in 2013 and 2014, increasing the number of sites located and documented by 36 percent.
Inventory	Percentage of park intensively surveyed.		The majority of human use of the Glacier Bay area is thought to have been limited to a relatively narrow band along the coastal shoreline with some inland sites known to occur along riverine systems and alpine ridgetop. Glacial advances during the Little Ice Age destroyed any archeological sites in the lower portion of Glacier Bay proper and isostatic depression destroyed nearshore sites dating to the Holocene along Icy Strait. Hence, archeological investigations have focused primarily on shoreline sections of the park along Icy Strait, Dundas and Taylor Bays (post Little Ice Age records), the Outer Coast and throughout Dry Bay. Although the exact percentage of shoreline surveyed has not been calculated, archeologists estimate that 25% of appropriate coastline has been surveyed.
	Percentage of archeological resources with complete, accurate, and reliable data in the Archeological Sites Management Information System (ASMIS).		20% (29 out of 147) of archeological sites in ASMIS have data for all required fields.
Certified Condition	Percentage of archeological resources certified as complete, accurate, and reliable in the Archeological Sites Management Information System (ASMIS) in good condition.		Of the 147 sites identified in the park, 94 (64%) are in good condition and are certified as complete, accurate, and reliable in ASMIS. During the 2013 and 2014 archeological surveys, staff relocated and documented the condition of some previously identified sites and found all to be in good condition. Those sites that have not been evaluated recently are likely in similar condition.

Resource Brief: Cultural Resource Inventories

As of 2016, there have been three large scale organized attempts to systematically inventory the cultural resources within GBNPP and two small limited scale survey efforts. The first of the two small-scale inventories was conducted in 2014 and focused on seal hunting within Glacier Bay (Bacon-Schulte 2014). The second consists of inventories conducted within Fingers Bay, Beartrack Cove, and Strawberry Island. This inventory was conducted to provide a baseline data set for determining future impacts to cultural resources due to park utilization by researchers and visitors (Bacon-Schulte 2015).

The first of the large-scale inventories was conducted during 1963–1965 by Ackerman of Washington State University (Ackerman 1964, 1965, 1968). The Ackerman inventory was conducted to ascertain a better understanding of the cultural resource landscape present in GBNPP and to give the park's resource managers a baseline for managing cultural resources within the park. This survey primarily focused on archeological sites in Icy Strait and on the GBNPP outer coast (Ackerman 1968: Figure 25). During this inventory, 59 archeological sites were recorded (Ackerman 1968:89–91).

Representative Culturally Modified Tree in Glacier Bay National Park. NPS Photo.

The second inventory was conducted 30 years later (in 1995) by the Smithsonian Institution's Arctic Studies Center (Crowell et al. 2013). This inventory was conducted to identify and document shoreline resources within the park so cultural resource managers could better manage this specific resource type in the event of an off shore disaster, specifically an oil spill. This survey primarily focused on a stretch of coastline between Icy Point and Point Carolus (Crowell et al. 2013). During this inventory, 42 archeological sites were either newly recorded or revisited (Crowell et al. 2013).

During the most recent large-scale inventory, in 2013, the NPS conducted an archeological inventory with a focus on culturally modified trees (Howell et al. 2013). This inventory was conducted to re-document previously identified archeological sites, assess their conditions and update database records and to inventory park lands for undiscovered archeological sites and document them in those databases. This survey focused on areas scattered along Icy Strait from Excursion Inlet to Cape Spencer, and in Glacier Bay proper as far north as Reid Inlet and Muir Inlet (Howell et al. 2013). During this inventory, 38 archeological sites were newly recorded and 30 previously recorded sites were revisited (Howell et al. 2013).

Cultural Anthropology and Tlingit Connection to Ancestral Lands

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park's ethnographic resources to the historic context(s) for the park.		Although the park has not completed an Ethnographic Overview and Assessment for either the Park or the Preserve, existing park staff has extensive expertise in, and knowledge of, ethnographic resources. The majority of formal ethnographic research has focused on pressing issues in the Park including traditional uses and effects of visitor use on ethnographic resources. For example, the park collected ethnographic information related to the traditional use of glaucous-winged gull eggs (Hunn et al. 2002), indigenous involvement in commercial fishing (Langdon, unpublished), traditional seal hunting practices (Austin, unpublished), and effects of cruise ships on traditional cultural properties (Deur and Thornton 2014). Considerable work has also been conducted on collecting traditional place names and traditional stories associated with those places. Ethnographic work in the GBNPP has been limited to a 20+ year old "Project Jukebox" and a recent focus on traditional cultural properties. Other, non-NPS sponsored ethnographic research is available for GBNPP. Much of the ethnographic research has not been published, and there is moderate concern that it will become increasingly difficult to access over time. As importantly, traditional people's relationship to GBNPP is evolving rapidly, and some information collected in earlier studies may be outdated.
	The scope of resources significant to affiliated groups associated with the park is understood and a determination has been made whether or not they are a fundamental resource or other important resource or value.		The park conducts formal consultation with two affiliated tribal governments twice each year and last year reinitiated tribal consultation with another affiliated tribal government. The park has collaboratively sponsored numerous workshops with affiliated groups to identify resources of concern as well as issues related to traditional uses. The park has duty-stationed staff in two traditional villages to increase the park's understanding of issues of concern to traditionally affiliated people. The passing of many elders in recent years requires that the park renew efforts to understand the values and issues of a younger generation.
	Percentage of cultural anthropology baseline documents with current and complete information.		The park has produced few baseline documents despite considerable efforts focused on collecting ethnographic information. One draft of an ethnographic overview and assessment for the Park is 50% complete; an ethnographic overview for the Preserve has not been initiated. The Park has had difficulty in finalizing reports and documents due to funding shortfalls, staff shortages, and failure of contractors to complete reports, pressing priority issues, and lengthy consultation processes. Funding for report and/or publication efforts is not available. Staff and/or contractors with institutional knowledge to complete publications may soon be unavailable.

Cultural Anthropology and Tlingit Connection to Ancestral Lands (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge (continued)	Traditionally associated groups, and the legislative, regulatory, or policy basis for relationships with them, are identified.	⇔	The park has a clear understanding of the appropriate traditionally associated groups tied to particular locations within the Park and Preserve and has developed strong and healthy relationships with most traditionally associated groups including three federally recognized tribal governments, one non-federally recognized tribal government, and three ANCSA regional and village corporations. The park has a well-defined and effective consultation process with both tribes and corporations. The park has duty-stationed staff in remote, native communities (Hoonah and Yakutat) in large part to ensure timely and healthy communication with tribal governments, tribal members and other related tribal entities.
	Percentage traditional cultural properties (TCP) with adequate National Register documentation.	↑	Ten TCP's have been identified for Glacier Bay NPP; of these, 6 nomination packages have been prepared but have not been submitted to SHPO as the park awaits confirmation from the tribal government. One TCP was identified at Indian Point, encompassing the park satellite office in Juneau, Alaska. A nomination package for this TCP, submitted by Sealaska, Inc., was listed in the NRHP in 2016. The park is currently collaborating with Portland State University to identify TCP's and prepare nomination packages for properties located within the Preserve.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.	↑	Long term cultural resource staff with institutional knowledge is currently available to provide cultural input into planning documents, regulatory language, policy, etc. Ethnographic information is available and used to assist in planning. For example, the park uses ethnographic information in the preparation of various NEPA and compliance documents, research permits, and park interpretive programs/media including those associated with the installation of climate stations, interpretive exhibits, interpretive brochures, etc.
Tlingit Connection to Ancestral Lands	Sufficient research exists to understand Tlingit traditions and life ways and the relationship between these traditions and the historic context(s) for the park.	⇔	The park has focused considerable effort over the last 25 years on the collection and preservation of traditional knowledge; specifically, knowledge associated with the history of Tlingit uses of ancestral homelands in GBNPP. The park collaborated with affiliated tribes and other native entities to collect information on traditional place names (Hoonah Indian Association [HIA] 2006), cultural fisheries (Langdon, unpublished; NPS, unpublished), gull egg harvesting practices (Hunn et al. 2002), and traditional seal hunting practices (Austin, unpublished). Park staff has also collected and/or compiled sound files of traditional stories and Tlingit history and have completed 25+ hours of translations and transcriptions. Existing park staff is well integrated into traditional communities and carries extensive knowledge of Tlingit history and lifeways.

Cultural Anthropology and Tlingit Connection to Ancestral Lands (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Tlingit Connection to Ancestral Lands (continued)	Park policy and programming facilitates intergenerational transmission of traditional knowledge.	⇧	The park has sponsored and/or co-sponsored numerous workshops focused on gathering traditional knowledge and has supported efforts in the communities of Hoonah and Yakutat to ensure that such knowledge is transmitted over time. Specifically, for 20+ years, the park has sponsored "Journey to Homeland" trips (1–4 annually) during which elders and culture bearers convey traditional information to youth while visiting the park and/or preserve. In 2013–2015, GBNPP collaborated with Hoonah City Schools and Hoonah Indian Association to develop and implement a series of culturally responsive curricula including a 2-month classroom based lesson plan and related field experiences and a summer camp for middle school youth. Additionally, activities associated with the planning and development of the Huna Tribal House, have provided opportunities for transmitting cultural knowledge. The park-sponsored Tribal House carving program has provided a venue for Hoonah youth to learn not only carving and weaving techniques, but to learn the history and traditions of the Huna Tlingit as portrayed in the elaborately carved and painted house screen, house posts, and house front. Both carving and spruce root weaving workshops have been sponsored through this program. The Tribal House Ground Blessing Ceremony, held in the park in spring 2015 provided another opportunity for youth to witness and participate in a traditional celebration, as did the dedication of the Whale 68 display in Bartlett Cove. The opening dedication of *Xunaa Shuká Hít*, the Huna Tribal House, occurred on August 25, 2016. The dedication focused on the return of the Huna Tlingit to their homeland, the encouragement of inter-generational learning, and the healing and strengthening of relationships between the Park and the tribe. Park assistance with the Alaska Native Voices Educational Institute (ANVEI) cruise ship, interpretive, programs provides another mechanism for tribal youth to study and subsequently convey traditional knowledge.

Cultural Anthropology and Tlingit Connection to Ancestral Lands (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Tlingit Connection to Ancestral Lands (continued)	Available traditional knowledge is applied to maintain those traditions that sustain Tlingit relationship with ancestral homeland.	⇧	Various park sponsored activities including Journey to Homeland trips, culturally responsive curricula, carving and weaving workshops, and resource-harvesting trips have renewed traditionally associated people's ongoing connection to homeland in the park. Such NPS-sponsored efforts have ensured that many tribal members (perhaps 150–300 individuals/year) engage in some traditional activity in homeland and even more engage in off-site traditional activities related to their ancestral tie to Glacier Bay. For example, the Tribal House carving shed venue engages 300–500 community members annually and Hoonah middle and high school youth participated in 50+ hours of curricula related to Glacier Bay in 2013–2015. While NPS-sponsored events have been an important venue for connecting tribal members with traditional homeland, individual and/or family-level connection has been more challenging. The cost and logistics of accessing GBNPP make it difficult for tribal members to visit on their own.
Partnerships with Native Groups	Number of partnerships with traditionally associated groups.	⇧	The park has numerous strong, effective partnerships with traditionally associated groups; the majority of cultural resource staff time is focused on building and maintaining these partnerships. The park has partnered on various programs including the Huna Tribal House, Journey to Homeland trips, gull egg harvest issues, and First Bloom with Hoonah partners including Hoonah Indian Association (HIA; the federally recognized tribal government), Huna Heritage Foundation (HHF; the non-profit arm of the village corporation), and Hoonah City Schools (HCS). Park and Preserve staff partner with Yakutat Tlingit Tribe (a federally recognized tribal government) on Journey to Gunaaxoo Kwáan Homelands and identifying traditional cultural properties. Other partnerships include Huna Totem Corporation (the village corporation), Douglas Indian Association (a federally recognized tribal government), Aák'w Kwáan (a non-federally recognized tribe), and Sealaska, Inc. (the regional corporation).
	Number of partnerships with traditionally associated groups formally documented.	⇧	In 1995, the park signed a Memorandum of Understanding (MOU) with HIA; this agreement has been reauthorized every five years. The park has signed Cooperative Agreements (and/or amendments) with HIA every year since 2010 to partner on the Huna Tribal House design and development. In 2015, the park prepared a draft General Agreement between NPS, HIA, and ANVEI to formalize an ongoing program whereby native guides provide interpretation aboard cruise ships in Glacier Bay NPP. The park has signed Cooperative Agreements with Yakutat Tlingit Tribe every year since 2013 to implement Journey to Gunaaxoo Kwáan Homeland programs.

Cultural Anthropology and Tlingit Connection to Ancestral Lands (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Special Sites	Number of special places effectively managed in partnership with traditionally associated groups.	⇧	In addition to traditional cultural properties and archeological sites, the park manages special sites of importance to traditionally associated people. For the most part, these sites lie within the Bartlett Cove developed area and include the Ceremonial Beach (the site of the 1992 Peaceful Demonstration of the Huna Tlingit), Canoe Shed (a display of a traditional canoe carved by Huna Tlingit), Whale 68 Display (the skeletal remains of a humpback whale, dedicated and named by the Whale Screen House of Huna), and the Huna Tribal House. In the past five years, the park has increased efforts to collaborate with HIA in protecting and interpreting these sites. For example, new wayside exhibits lead visitors from the Ceremonial Beach to the Tribal House and an ethnobotany trail provides visitor information about traditional plants and their uses.

Resource Brief: Journey to Homeland

A Huna Tlingit elder speaks to students in the classroom.

For almost 20 years, NPS and partners Hoonah Indian Association, Huna Heritage Foundation, and Hoonah City Schools (HCS) have sponsored "Journey to Homeland" trips, carrying hundreds of students and community members to Glacier Bay NPP to learn about, and maintain connections with, the traditional homeland of the Huna Tlingit, Sít' Eeti Geeyí. Trips have ranged from single day visits to tidewater glaciers, to berry picking forays, to extended backcountry youth kayak trips. In recent years, NPS and Hoonah partners developed a more comprehensive approach to these annual trips—one that involves professionally developed classroom-based curricula, longer (3–5 day) field experiences that rotate annually to different parts of the park, and a culminating community presentation.

These in-school programs and "immersion" trips have been very successful in encouraging students to explore the history and culture of the Huna Tlingit through both western and traditional means. Using scientific information, elders' wisdom, explorer's field notes, historic photographs, and physical artifacts, the students are asked to build upon their understanding of the Huna Tlingit's inextricable tie to Glacier Bay. In 2015, for example, Glacier Bay staff partnered with school faculty and the tribe to implement curricula in high school Alaska History and Earth Science classes focused on "How the Glacier Bay Landscape Shaped, and was Shaped by, Tlingit Culture." In the classroom, and during a 3-day trip to Dundas and Taylor Bays, students learned mapping techniques; explored landforms and geological forces; identified the criteria their Huna ancestors used to select settlement sites; read and compared traditional stories associated with Glacier Bay; examined artifacts for clues about Huna history; and sketched landforms, artifacts, and natural elements. Elders and culture bearers presented traditional knowledge, clan stories, and described historic events in the classrooms as well as on the 3-day wilderness journey.

NPS sponsors such programs through cooperative agreements with the tribe and the school, believing that such programs will foster academic excellence, maintain traditional knowledge, instill pride in cultural heritage, build youth leadership skills, and strengthen ties between native students and their traditional homeland.

Students from the Hoonah City School learn about the history and culture of the Huna Tlingit through western and traditional means. A park ranger works with a group of students in Glacier Bay

Resource Brief: Xunaa Shuká Hít

The Xunaa Shuká Hít—roughly translated as "Huna Ancestors' House"—is the first permanent clan house in Glacier Bay since an advancing glacier destroyed Tlingit villages over 250 years ago. A long awaited dream, it will be a gathering place where tribal members can reconnect with their treasured homeland through ceremonies, workshops, camps, tribal meetings and other events. It will also provide thousands of park visitors with opportunities to learn about Huna Tlingit history, culture, and life ways.

Xunaa Shuká Hít, the Huna Tribal House, stands on the shores of Bartlett Cove.

The Hoonah Indian Association (HIA) and NPS have worked closely with a team of clan leaders, craftsmen, planners, architects, and cultural resource specialists to design a building that reflects traditional architectural styles but meets the needs of contemporary tribal members as well as park visitors. The focal point of the Tribal House is a large open gathering area with a central fire pit, but modern amenities including utilities, a small kitchen for preparing native foods, dressing room for dancers and performers, and detached restrooms have been incorporated in the building. The Tribal House opening ceremony in August 2016 drew 800 tribal members and visitors.

Glacier Bay NPP is the ancestral homeland of the Huna Tlingit clans who sustained themselves for centuries on the abundant resources of the land and sea. Although the Little Ice Age glacial advance of the 1700s overran villages inside the Bay, the Huna Tlingit re-established numerous fish camps and several villages in Glacier Bay soon after glacial retreat. The Huna Tribal House will memorialize the clan houses that once lined the shores of present day Bartlett Cove, now the site of Park Headquarters.

A carver puts finishing touches on a post for the Tribal House.

The Tribal House program has also provided an opportunity to revitalize and preserve Tlingit artisanal traditions. Through a cooperative agreement between the tribal government and NPS, master craftsmen have trained a cadre of local apprentices and students in traditional Tlingit art and design, carving, adzing, and spruce root weaving. Over the past four years, carvers have crafted an elaborately carved and painted cedar panel to serve as the house front, four richly detailed massive cedar interior house posts to support the houses main beams, and an interior panel—or house screen—which depicts the stories of the four primary Huna Tlingit clans. Craftsmen also carved totem poles while apprentices focused on hand-adzing the lumber needed to clad the interior and exterior of the Tribal House. These precious cultural elements will impart spiritual value to the Tribal House, but as importantly, their design and completion has expanded the circle of tribal members who share in cultural knowledge.

Resource Brief: Resuming Tlingit Harvest of Gull Eggs in Glacier Bay

For centuries, the Huna Tlingit harvested gull eggs at rookeries scattered throughout the recently deglaciated islands of lower Glacier Bay. Egg harvests not only provided a healthy spring food source, but also served as a mechanism for families to bond through intergenerational food harvests. These traditional harvests were curtailed in the 1960s when the NPS began enforcing the Migratory Bird Treaty Act and related NPS policies that prohibited egg harvest.

In recent years, NPS and the Hoonah Indian Association (HIA) have collaborated on a range of programs designed to encourage and reinvigorate cultural activities within the park, including the harvest of gull eggs. In 2010, the NPS prepared a Legislative Environmental Impact Statement that determined that egg harvest could occur within the park without affecting gull populations or other park resources. Based on these findings, Congress passed legislation in 2014 authorizing harvest of glaucous-winged gull eggs in Glacier Bay National Park and Preserve.

Hoonah harvesters measured and collected gull eggs while NPS biologists recorded nest site locations and egg sizes during an experimental Tlingit gull egg harvest on Flapjack Island, Glacier Bay. NPS Photo by Christopher Behnke.

With the long awaited passage of this legislation, NPS can now promulgate the necessary regulations to implement the law and a collaborative NPS-HIA working group can begin to develop the first gull egg harvest plan. This harvest plan will be developed and implemented at the local level to meet the needs of the Hoonah community and provide guidelines to insure sustainability of the gull egg harvest for future generations. The gull egg harvest is unique to Glacier Bay National Park and is not part of the Federal Subsistence Program or subject to NPS subsistence regulations. Rather, it will be administered as a partnership between the park and the Hoonah Indian Association to maintain cultural connections ensuring protection of the resources.

In the meantime, Glacier Bay NPP managers are collaborating with HIA to collect information on glaucous-winged gulls to inform future egg harvests. Since 2012, park biologists have monitored gull populations at six potential harvest sites. In 2015, biologists collaborated with HIA on an experimental research harvest of eggs to determine the impact of egg harvest on the timing of egg laying, number of eggs per nest and per colony, and egg size. During this project, four tribal members joined the park cultural anthropologist, wildlife biologist, and wildlife technician on the park's research vessel to visit two gull colonies pre-selected for this experimental harvest. Tribal members collected one hundred gull eggs from two colonies and assisted NPS biologists in conducting a full census of nests and contents and measuring harvested eggs. The harvested eggs were distributed among Huna elders and other tribal members and used to bake cupcakes for a school picnic to help reintroduce children to this culturally important food.

Cultural Landscapes

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research exists to understand the relationship of the park's cultural landscapes to the historic context(s) for the park.		Cultural Landscape Inventories (CLIs) have been completed for Bartlett Cove (2003), Dundas Bay (2003), and Glacier Bay Lodge Complex Historic District (2011). Six other cultural landscapes have been identified but have not been documented: Berg Bay, Cape Spencer, Dry Bay, Excursion Inlet, Ibach Cabin/ Garden Remains, and Lituya Bay.
	Cultural landscapes are identified and evaluated using appropriate historical contexts.		All three completed CLIs have been evaluated using appropriate historical context.
	Percentage of cultural landscape baseline documents with current and complete information.		Of the three completed CLIs, all (100%) have current and complete information. However, Cultural Landscape Reports have not been completed.
Inventory	Percentage of landscapes eligible for the National Register in the Cultural Landscapes Inventory (CLI) with certified complete, accurate, and reliable data.		Of the nine CLIs identified, only three (33%) have been evaluated.
Documentation	Percentage of cultural landscapes with adequate National Register documentation.		None of the nine CLIs identified have adequate National Register documentation.
	Percentage of cultural landscapes with Determination of Eligibility (DOE) documentation.		Of the three CLIs that have been evaluated and determined eligible by the SHPO as CLIs, none have formal DOE documentation.
Certified Condition	Percentage of cultural landscapes certified as complete, accurate, and reliable in the Cultural Landscapes Inventory (CLI) in good condition.		100% of the three documented cultural landscapes in the CLI are in good condition.

Historic Structures

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the relationship of the park's historic structures to the historic context(s) for the park.		Of the 38 historic structures recorded, 35 have Cultural Landscape Inventory or National Register nominations. These structures are within the Glacier Bay Lodge Complex Historic District, the CAA Airfield Compound Historic District, Dundas Bay Cultural Landscape Inventory, and the Headquarters Site for Administration of Sitka and Glacier Bay Monuments Historic District.
	Historic Structures are identified and evaluated using historical contexts.		The Glacier Bay Lodge Complex Historic District, the CAA Airfield Compound HD, and Dundas Bay Cultural Landscape Inventory, have all been identified and evaluated using the historical context of Military Development and Infrastructure; Entrepreneurship and Exploitation; Homesteading and Related Settlement; and Scientific Study and Tourism. The Headquarters Site for Administration of Sitka and Glacier Bay Monuments Historic District is significant for its association with the National Park Service's administrative history.
Inventory	Percentage of historic structures eligible for the National Register in the List of Classified Structures (LCS) with accurate, complete, and reliable data.		71% (27 out of 38) of historic structures in the LCS have accurate, complete, and reliable data.
Documentation	Percentage of historic structures with adequate National Register documentation.		None (0%; 0 out of 38) of the historic structures in the park has adequate National Register documentation. The park completed draft documents for five historic structures; four drafts are near completion (90% complete) including those for the Glacier Bay Lodge Complex Historic District, Headquarters Site for the Administration of the Sitka and Glacier Bay National Monuments, the CAA Airfield Compound Historic District and Lagoon Island Cabin.
	Percentage of historic structures with Determination of Eligibility (DOE) documentation.		92% (35 out of 38 historic structures) have DOEs.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		Long term cultural resource staff with institutional knowledge is currently available to provide cultural input into planning documents, regulatory language, policy, etc.

Historic Structures (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Certified Condition	Percentage of historic structures certified as complete, accurate, and reliable in the List of Classified Structures (LCS) in good condition.		69% (27 of 38) of historic structures in the LCS are in good condition based on recent condition assessments conducted in 2011. Most of these structures are located in the Bartlett Cove developed area and are associated with the Glacier Bay Lodge Complex Historic District. Although listed in "good" condition on the LCS, many buildings in the Glacier Bay Lodge Complex HD are deteriorating due to significant deferred maintenance. There are likely ongoing, unidentified deferred maintenance needs for this facility. Glacier Bay's general management plan outlines a park policy of benign neglect for historic structures located in wilderness (including structures in the Dundas Bay cemetery, the Dundas Bay cannery, the Harbeson Cabin, Harbeson woodshed, and the Ibach Cabin). These latter structures are not managed other than to ensure visitor safety and are in fair or poor condition. The park will be evaluating the Lagoon Island Cabin, a historic structure located across from NPS headquarters, to determine park policy in light of recent findings that Lagoon Island has been incorrectly classified as wilderness.

History

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Sufficient research is conducted to understand the national significance and historical contexts for the park.		Three research efforts resulting in publications, documented an administrative history of the park, an overview of the historic resource contexts, and a history of commercial fishing. These are: *Land Reborn: A History of Administration and Visitor Use* (Catton 1995); *Glacier Bay NP & P Historic Resource Study* (Kurtz 1995); and *Navigating Troubled Waters: A History of Commercial Fishing in Glacier Bay, Alaska* (Mackovjak 2010). Five Multiple Property Nominations to the National Register of Historic Places were developed as a result of the GBNPP Historic Resource Study. These nominations were approved in 1996. The park has not adequately documented recent administrative history. The administrative history available (*Land Reborn*) is outdated and may contain factual errors. Significant administrative issues, park policy changes, and new park programs including the park's long history of research, advances in natural and cultural resource programming and coordination, and advances and changes in vessel management have not been well documented. Administrative records are not well compiled, collated, and/or archived.

History (continued)

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Inventory	Cultural resources are inventoried and evaluated in consultation with State Historic Preservation Officers (SHPOs).		All projects that could potentially affect cultural resources are consulted about with the SHPO in either an annual meeting, or on an as needed basis.
	Research results are disseminated to park managers, planners, interpreters, and other NPS specialists and incorporated into appropriate park planning documents.		Long term cultural resource staff with institutional knowledge is currently available to provide cultural input into planning documents, regulatory language, policy, etc. Some historical contexts may not be available to park managers, planners, interpreters and other staff as more recent (i.e., in the last 50 years) administrative histories have not been well documented.

Museum Collections

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Scope of museum collection in the park is understood and a determination has been made whether or not they are a fundamental or other important resource.		The scope of museum collection is quite outdated (1998) and although a revised draft was prepared in 2012, it has not been completed. Since that time, the park has expanded several research efforts (both natural and cultural) which are not adequately reflected in the scope of collections.
	Percentage of museum collection baseline documents with current and complete information.		All museum collection baseline documents are outdated or non-existent including the Collections Management Plan (1989) and Scope of Collections Statement (1998). The park does not have the required Integrated Pest Management Plan, Museum Collections Emergency Operations Plan, or Museum Collections Structural Fire Plan. The park does not have collections staff with the skills to update these documents.
Inventory	Archival and manuscript collections are surveyed and described in the Interior Collections Management System (ICMS) and finding aids are produced.		The 2015 Collections Management Report states that 89% of the park's archival collection was surveyed and described in ICMS; however, 50% of this collection has not been incorporated into the established NPS hierarchy and must be re-cataloged. In addition, the current finding aid is difficult to use and needs to be updated.

Museum Collections (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Documentation	Accession and deaccession files are complete with all appropriate signatures.		Approximately 50% of the accession and deaccession files are complete. Files lacking appropriate signatures are currently being amended or annotated during the annual inventory.
Certified Condition	Percentage of museum collection reported in Collections Management Report (CMR) and checklist report in good condition.		Glacier Bay has 10,295 records in ICMS. Of those, 98.1% are in good or excellent condition.

2.3. Visitor Experience

Visitor Numbers and Visitor Satisfaction

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitor Numbers	Number of visitors per year		The total of 551,353 visitors to the park in 2015 shows a steady increase of 20% over the last 5 years. The vast majority of park visitors (95%) arrive on cruise ships and tour boats, experiencing the wonders of Glacier Bay for one day as part of a longer Inside Passage itinerary. Cruise ship passenger capacity is the primary driver and ships are consistently booked at 103–105% occupancy. In recent years, some cruise passengers are booking both northbound and southbound cruises as part of the same vacation. Over the years, as cruises have become more affordable, independent travelers have become a very small minority of park visitors. Approximately 10–20,000 visitors seek out more of Glacier Bay and spend time in Bartlett Cove. Most stay at the Glacier Bay Lodge, at lodges in nearby Gustavus, or camp. Many experience the park via the daily concession-operated boat tour. With no entrance station, it is difficult to obtain accurate numbers of independent travelers, yet it is anticipated that with the completion of the Tribal House, Bartlett Cove may become more of a destination, and land visitors could increase in future years. *Sources: GBNPP SIR Report, NPS Visitor Statistics and GBNPP Vessel Statistics*
Visitor Satisfaction	Percent of visitors who were satisfied with their visit		Based on the standard visitor satisfaction survey conducted each year, park visitors are very satisfied with Glacier Bay's facilities and services. The percentage of visitors satisfied in FY14 was 98%. Over the past five years, Glacier Bay has consistently achieved satisfaction scores of 96–99%. Numerous visitor comment cards also indicate overall satisfaction with their visit to Glacier Bay. *Sources: Visitor Survey Card Data Reports, visitor comment cards*

Resource Brief: Interpretation at Sea, Cruise Ship Rangers!

The first cruise ship, the steamer Queen entered Glacier Bay in 1883. One hundred and thirty years later the vast majority (95%) of Glacier Bay's visitors still enjoy the park from the decks of large ships. Spectacular scenic cruising, a close approach to tidewater glaciers, and the opportunity to view Alaskan wildlife, make Glacier Bay a highlight of the Inside Passage, and a coveted itinerary for cruise line companies. For passengers, one of the many memorable aspects of the Glacier Bay day is the NPS enrichment provided onboard. As each ship enters the bay, a small team of Interpretive Park Ranger/Naturalists is waiting.

The Serac, the park's pilot boat, meets the ship and facilitates an underway transfer. The team of rangers carefully climbs aboard to spend the day sharing stories of this amazing place and enriching the visitors' park experience. Rangers provide a wide variety of services, and even bring aboard a "traveling visitor center" with displays, maps, and props. This contact station is setup in the primary viewing lounge, and staffed by park rangers and our Alaska Geographic partners while the ship journeys through "glacier country." Meanwhile, passengers enjoy a ranger narrative from the bridge, and formal illustrated presentation in the ship's theater (with up to 900 in attendance). Roving, wildlife viewing, and an on-board Junior Ranger program round out the action-packed day, facilitating lifelong memories for park visitors.

Above: **a cruise ship enters Glacier Bay;** ***Above inset:*** **cruise passengers line the railings to get an up-close look at a tidewater glacier;** ***Right:*** **a ranger points out glacial features. NPS Photos.**

Interpretive and Education Programs – Talks, Tours, and Special Events

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Education Programs	Range of opportunities, quality and quantity of programs		Glacier Bay NPP provides a wide range of education programs reaching diverse geographic audiences. Curriculum based programs are provided in person with the local Gustavus school as well as in Hoonah through the National Park Foundation First Bloom Program. Curriculum based cultural and natural history programming is regularly presented in conjunction with local schools. In recent years, Glacier Bay NPP has endeavored to provide education programs to distant and diverse audiences through video conferencing to schools across North America. These long distance programs have increased, from 464 students in five states in 2012, to reaching more than 2,989 in 18 states and 1 Canadian Province in 2015. These programs reach diverse and underserved youth. Glacier Bay NPP received the prestigious Pinnacle Award for the third year in a row from the Center For Interactive Learning and Collaboration based on excellent teacher evaluations of Glacier Bay NPP's programs. Rangers also respond to countless student inquiries with information for school reports and projects. *Sources: GBNPP SIR Report, CILC Teacher Evaluations*
Outreach and Youth Programs	Range of opportunities		There are increasing opportunities for public participation in park programs through outreach efforts and youth programming. Rangers developed programs for neighboring communities, including Excursion Inlet Cannery, and planned a comprehensive Every Kid in the Park event for fourth grade students from surrounding remote communities in spring 2016. Glacier Bay NPP education rangers have participated in Juneau's SeaWeek program for several years. Park researchers provide presentations at conferences and for area organizations. Comprehensive youth programming includes a variety of field based Discovery Days, Arts in the Park, field-based experiences, Fishing Day, Bear Safety, Ranger Job Shadowing and Internship, and Library READ programs. *Sources: SIR Report, Outreach Report*

Interpretive and Education Programs – Talks, Tours, and Special Events (continued)

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Ranger Programs	Number and quality of programs and attendance	⇧	Glacier Bay NPP offers unique opportunities for rangers to provide programs to a wide audience on ships, boats and land. Interpretive contacts have increased from 663,565 in 2011 to 783,096 in 2015. Glacier Bay provides the highest number of facilitated interpretive programs in the NPS AK Region. Programs range from shoreline guided hikes to cruise ship public address commentary. On cruise ships, a "Mobile Visitor Center" is brought on-board, providing informal interpretation to thousands of visitors. Walks, Nightly Ranger Talks in the Lodge and other ranger-led talks and offerings are available during the summer season. Regular informational backcountry and boater orientations are provided at the Visitor Information Station. The interpretation program is evaluated annually to ensure the best balance of opportunities for visitors to experience ranger programs. Programs are professional and relevant, based on Glacier Bay NPP's interpretive themes. Glacier Bay NPP has among the highest level of visitor understanding of park significance in the NPS (96%). *Sources: SIR Report, GPRA Visitor Survey*
Junior Ranger Programs	Number of programs and attendance	⇧	Glacier Bay supports a strong Junior Ranger program on land and at sea! A strong partnership with cruise ships and tour boats ensures involvement with the next generation of stewards and advocates. On cruise ships, rangers provide special JR programs in onboard youth centers; these programs are well received. Rangers meet with cruise ship youth center staff each season to strengthen JR offerings. On tour boats, rangers present more in-depth programs with young passengers. A new Junior Ranger book for Bartlett Cove visitors was in development for 2016. Junior ranger programs reached 5,507 kids in 2011 and 7,106 in 2015. *Source: SIR Report, cruise ship youth center comments, visitor comments*
Special Events	Variety and longevity of events, community involvement	⇧	Park staff regularly schedules and hosts expert guest speakers to highlight recent research and cultural activities in the park. Alaska Geographic, the park's Cooperating Association, also hosts various programs including open houses, book signings, and special showings. Special events have increased in recent years due to completion of several unique park projects. The park has hosted celebrations for the humpback whale skeleton exhibit grand opening, an orca display in the Gustavus Library, and the tribal house groundbreaking. *Source: SIR report*

Resource Brief: Extending Our Reach with Long-Distance Learning

Remote and isolated, Glacier Bay NPP has always faced difficulties in reaching youth. Last year, over 2,000 students and teachers visited Glacier Bay NPP in the heart of winter without ever leaving their schools. Kindergartners spotted bears and sea otters, fourth graders catalogued humpback whale behaviors, and high school students explored the wide range of careers with the National Park Service. These students all visited Glacier Bay NPP virtually, using videoconferencing equipment to connect Glacier Bay rangers to classrooms across the country.

Rangers teach classes to students across the country using video-conferencing and green screen technology.

Although these programs have only been developed and offered for 5 years, they have already forged extremely strong connections with schools throughout the lower 48. Last year Glacier Bay NPP provided programming to 3,000 students in 18 states! Glacier Bay NPP is no longer an isolated park that few children will ever discover. Instead, it has become a fun, engaging, and meaningful place, where students as far away as Puerto Rico, New York City, rural Virginia, and even remote Alaskan villages can interact "live" with a park ranger, and realize the importance and relevance of our national parks and public lands.

Resource Brief: First Bloom and Hoonah Programs

First Bloom is a yearlong program that teaches youth the benefits of native plants through the planning and creation of native plant gardens. Youth groups partner with a local National Park Service unit to apply for grants administered by the National Park Foundation. Over the past five years, Glacier Bay National Park and Preserve has partnered with a variety of local youth groups, enjoyed many classroom visits, worked with youth to discover and celebrate native SE Alaskan plant life, and created three native plant gardens. The first was at the Alaska State Museum in Juneau with a local Girl Scout troop. Next, the park helped developed a garden in Gustavus with the 4th & 5th grade students from the Gustavus School. Most recently, a garden in Hoonah was started with the 5th & 6th grade students from the Hoonah School where the program has fostered positive, new relationships between the NPS and Hoonah community.

These garden projects lessons teach students the value of native plants, plant biology, teamwork, and by passing these gardens to younger students in the school, the ideas of stewardship.

Students establish a native plant garden at a local school. NPS Photo.

Resource Brief: Programming for Our Young Neighbors

Local preschoolers explore the intertidal area with a park ranger on a school field trip. NPS Photo.

Glacier Bay National Park and Preserve offers a wide variety of education and outreach programs to engage local youth in lessons about native flora and fauna, wilderness, and stewardship. Throughout the school year, virtually all students at the nearby Gustavus School participate in interpretive and educational programs. All-day boat trips to the glaciers, classroom visits, student participation, senior internships, and special topics remain highlights. In addition, each year the Gustavus 3rd–5th grade students participate in a yearlong study investigating different topics of the natural world (watersheds, water quality, intertidal productivity, and native food resources). In the spring, the elementary students look forward to their annual backpack and camp in the park's wilderness with teachers and park staff. For many of them, this is their first camping trip.

Throughout the summer months, the park's education staff develops and presents weekly "Discovery Days" summer camps for local youth and younger visitors. During National Youth Fishing Day, park interpreters and fishery staff work together presenting lessons on fish identification, salmon life cycles, and fishing techniques for youth. In recent years, the park has also worked with the local underserved audience at the nearby Excursion Inlet Cannery community to provide fun programs and youth activities introducing them to the value of our national parks.

Resource Brief: Artist-In-Residence

Over the past few years, Glacier Bay NPP has established a small, but successful, Artist in Residence program. The residency is participatory and service-oriented and conducted in partnership with the U.S. Forest Service's Voices of the Wilderness program. Selected artists spend one to two weeks in Glacier Bay National Park and Preserve assisting park staff with their duties, especially in areas of stewardship and conservation. While in residence, artists have accompanied rangers into the backcountry, monitored humpback whales and orcas, pulled equipment on oceanography surveys, presented at youth interpretive programs, and more. The service projects give artists a fuller understanding of the opportunities and challenges facing park managers while also drawing inspiration from the environment around them.

While in Glacier Bay, the artists have presented their work to the public. To date, Glacier Bay NPP has hosted composer Stephen Lias, photographer David Bahr, and watercolorist Michael Boardman. Park staff and artists look forward to the continuation of the Artist in Residence program in the future.

Artist in Residence, Michael Boardman, helping out at a summer youth program. NPS Photo.

Interpretive Media – Brochures, Exhibits, Signs, and Website

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Wayside Signs	Condition and currency of signs		A new suite of wayside signs and directional panels was installed throughout Bartlett Cove in 2014. In future years, additional panels will be installed in conjunction with the Tribal House.
Exhibits	Glacier Bay Visitor Center – quality and condition of facility		The current exhibit package needs replacement. It is extremely dated and is not up to NPS standards for professionalism and accessibility. The location of the park visitor center, upstairs in the lodge facility, is not readily visible or accessible to Bartlett Cove visitors. There is a proposal to develop a new combined facility with the Visitor Information Station (VIS) near the public dock and parking area for better customer service.
	Visitor Information Station (VIS) – quality and condition of facility		The VIS facility was upgraded recently by enclosing an open porch and rearranging the floorplan, yet the small space available makes meeting visitor needs less than optimum. Increasing public use for orientations and other purposes have further stressed the space. Reorganization and consolidation of visitor services available in Bartlett Cove is a continuing challenge.
	Humpback Whale Display and Canoe Display – quality and condition of facility		This new highlight for Bartlett Cove visitors was completed in 2014. It is the second largest outdoor humpback whale skeleton on display in the world. It has become a focal point for ranger programs, on site and remotely, reaching thousands of Glacier Bay NPP visitors. The carved Tlingit canoe exhibit was improved with new shingles and structural improvements and an improved information panel.
	Huna Tribal House		The park has constructed and opened a model facility to anchor the Tlingit people in Glacier Bay and provide unparalleled opportunities for the public to understand Tlingit Culture. This facility will also enhance recruitment and partnership with the Tlingit people.
Print Media	Quality and availability of primary park publications		Glacier Bay NPP offers a few high quality print publications. The annual park visitor guide, *The Fairweather*, was significantly revised and expanded in 2014. The Park Map was recently updated. A new Jr. Ranger book has been developed and will be distributed in summer 2016. Working with the park partner Alaska Geographic, park staff completed a brand new NPS Glacier Bay Handbook in 2014. The primary Trails Illustrated Map has been updated annually. A new leaflet in 2015, a Kayaker's Regulation Guide/Backcountry Permit was successfully produced. The importance of print material is decreasing in the park.
Audio-visual Media	Orientation Films – quality and relevance		The main NPS park film (*Beneath the Reflections*) while accurate, appears dated, so necessitates refreshing or replacement. A locally produced film, *Glacier Bay: Fountain of Life* is now regularly shown. The other primary film, *Forever Wild*, was updated and refreshed in 2011. Updated NPS orientation films for campers and boaters, produced in 2011 and 2012, are excellent and very useful for educating backcountry visitors.

Interpretive Media – Brochures, Exhibits, Signs, and Website (continued)

web ▸

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Audio-visual Media (continued)	Other AV material	⇧	With a stagnant, outdated Visitor Center, it is challenging to utilize relevant and innovative audiovisual displays. In other avenues, on board cruise ships and tour boats, the use of Wi-Fi hotspots and tablets with passengers has proven successful for expanding interpretive services. A new pre-program 15-minute film shown on cruise ships includes an audio-visual intro to Glacier Bay themes. New audio soundclips "Voices of Glacier Bay" are frequently visited on the website and incorporated into formal interpretive programs. A new NPS Story Map virtual tour boat visit went online in 2015. An underwater Hydrophone Kiosk in the Visitor Center plays live audio and selected audio clips from a Glacier Bay hydrophone. Currently, there are no park employees dedicated to only media, so projects are completed as time allows.
Websites	Currency and scope of website; number of website visitors	⇧	Visitation to the park website continues to grow (over 700,000 page views in 2015), and with the NPS centennial, there were record levels of site visits. The Glacier Bay NPP site is one of the most visited in Alaska. The park's digital media capacity is challenged without a full-time webmaster or media specialist.
	Social media: Facebook updates and "likes," overall activity	⇧	Glacier Bay NPP developed the AK Region's first Facebook page in 2011, and enjoys a robust and growing social media presence. Multiple divisions and staff provide postings, especially during the summer months. Some posts reach tens of thousands of fans. *Source: Facebook Insights*

Resource Brief: A Tale of Two Whales – Humpback and Orca Displays

For many years a "Skeleton Crew" of park employees, whale-bone specialists, and Gustavus community members worked together towards a common goal—to clean, repair, and articulate two unique whale skeletons. Both skeletons are now complete and on permanent display for visitors. These two amazing displays provide visitors with new, unique perspectives of Glacier Bay's amazing underwater world.

Making final touches on the massive articulated skeleton. NPS Photo.

Little Whale – The Gustavus Public Library now hosts a 12-foot juvenile killer whale skeleton. Her body was found in Glacier Bay in 2005. Her death was attributed to fishing gear found in her stomach. After cleaning the bones, the park partnered with articulation specialist Lee Post, the Gustavus Public Library, Gustavus School, and Alaska Geographic to transform her bones into an educational display. The final skeleton assembly took place in the school wood shop. During the opening ceremony, Tlingit elders named her "Keet'k" which means "little whale." In the library filled with countless stories, Keet'k will now share her own unique story with present and future generations.

A Whale Named Snow – In Bartlett Cove, visitors can now get up-close and personal with an immense humpback whale skeleton. In July 2001, a cruise ship struck and killed Whale #68 (aka Snow), a humpback whale observed in Glacier Bay regularly since 1975. The park turned this tragedy into an educational opportunity. The entire skeleton was collected and community volunteers toiled alongside park staff to clean her huge bones.

To prepare the skeleton for final display, the park contracted with articulation specialist, Dan DenDanto, of Whales and Nails. In 2012, Snow traveled by truck from Glacier Bay to Dan's shop in Maine. Dan spent the next eighteen months cleaning and preparing the huge skeleton. Snow returned home last summer, and is now a spectacular display. She is the second largest of only eighteen humpback skeletons on display worldwide. As part of the celebration of her return, she was honored with the Tlingit name "Tsalxáan Tayée Yaay," which translates as "Whale Beneath Mt. Fairweather."

Cutting the Ribbon on the amazing new humpback whale display. NPS Photo.

Recreational Opportunities

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Backcountry/ Wilderness Experiences	Diversity, quantity and quality of opportunities		The park offers a wide range of high-quality backcountry wilderness experiences including backpacking, mountaineering, kayaking, boating, and rafting on the Alsek-Tatshenshini River. Backcountry experiences take place primarily in undeveloped wilderness areas, which offer visitors unparalleled opportunity for solitude and unconfined outdoor recreation. Backcountry camping permits are required for Glacier Bay proper, and those have remained relatively constant, with an average of 871 visitors. *Source: VIS camper/ permit database* There is a need for inventory and monitoring of visitor impacts, and visitor use studies for backcountry and wilderness planning.
Tidewater Glacier Viewing	Quality and opportunity for viewing		Tidewater glaciers are a primary visitor attraction. Accessibility of tidewater glacier viewing is in the park's enabling legislation. Currently seven tidewater glaciers are accessible. Of those seven, three appear to be losing tidewater status. All except one are thinning/losing mass. Management concern about changing tidewater glacier viewing opportunities in the face of changing glacial conditions and response to resource protection guidelines. In addition, the costs of transportation has become an increasing issue with independent travelers.
Wildlife Viewing	Quality and range of opportunity		In addition to the glaciers, a visit to Glacier Bay NPP provides a wealth of opportunities to witness iconic Alaskan wildlife, both terrestrial and marine (e.g., humpback whales, sea otters, seabirds, harbor seals, sea lions, puffins, bald eagles, brown bears, moose). Over the past 200 years, the land has emerged from the last glacial advance resulting in a variety of habitats supporting diverse plants and animals. While humpback whales and sea otters have increased in population, other species such as harbor seals have declined. This variability in wildlife populations as well as seasonal variations and weather conditions ensures that no two visits are ever the same.

Recreational Opportunities (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Campgrounds	Occupancy and Visitor satisfaction	⇧	GBNPP has 2 designated campgrounds. A walk-in, tent only campground in Bartlett Cove, and a primitive, remote campground near the Dry Bay airstrip. Bartlett Cove Campground camper numbers and use days have increased over the last five years (393/761 to 599/1270), since Alaska Marine Highway ferry access started in 2011. There have been recent improvements to Bartlett Cove Campground facilities, and visitor satisfaction of this walk-in campground has remained very high. Ferry service has also brought increased vehicle camping expectations (e.g., RV use) yet Bartlett Cove facilities are not designed to accommodate RVs or car camping. A Frontcountry Management Plan is needed to plan how the park will address these needs. The Dry Bay campground is primitive, and utilized regularly by rafting groups, yet currently lacks any functioning facilities.
Boating	Quality and Quantity of opportunities	⇩	Boating in Glacier Bay NPP remains extremely popular. The number of vessels in Glacier Bay proper is limited during the busy summer months through a vessel management and permit system. During prime boating season, the bay is usually "full" and advanced notice permits are unavailable. The park implements a number of regulations that restrict vessel access or alter vessel behavior to protect natural resources (e.g., humpback whales, harbor seals, nesting seabirds) during times and in locations of greater sensitivity. Park waters are managed to provide diverse recreational opportunities for both motorized and non-motorized vessels. Boating permits have remained steady, with an average of 529 permits per year. Recently, there have been changes in where permitted boaters go in the park and the type of activities that boater are engaged in. There is concern among management that the quality and diversity of experiences has decreased as the proportion of boating permits used primarily for lower-bay fishing based out of Bartlett Cove reduces the number of permits available for park exploration in the upper bay.

Recreational Opportunities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Kayaking	Quality and range of opportunities	⇧	Visitors utilize kayaking as a way to explore the vast expanses of Glacier Bay's waters and wilderness shorelines. Trips vary from short daytrips from Bartlett Cove to extended backcountry adventures with rentals and guided trips available. The park facilitates a backcountry kayak drop-off service through the concessionaire's day boat. By managing the drop-off locations and schedules, the park disperses campers to reduce impacts and enhance wilderness experiences. In addition, the park manages extensive areas of the bay as wilderness non-motorized waters. A balance in management of day boat uses for kayak drop-offs versus wilderness viewing is a continuing challenge. Ferry service to Gustavus has made it possible for kayakers to bring their own boats. The number of kayakers has remained steady over the last five years. *Source: VIS data 2010–2015.* Camping areas from Wolf Creek to Mount Wright were opened to overnight camping for kayakers on multi-day trips.
Sport Fishing – Marine	Quality and range of opportunities	⇩	Marine anglers harvest primarily Pacific halibut and Chinook and coho salmon and a much smaller component of anglers target crab, shrimp and other marine fish species. Overall management concern due to reduction in bag limits as well as anecdotal information that suggests increased fishing effort expended to obtain bag limit and smaller fish retained. Reduced halibut bag limit in concert with specific size limits exist for charter anglers relative to unguided anglers. Non-pelagic rockfish bag limits have declined from 3 to 2 fish for residents, depending on spatial location. Dungeness crab harvest has essentially ceased, most likely due to increasing sea otter abundance and predation. More than 11,000 anglers on average (range 8,121–14,107) reported fishing within the Glacier Bay area (Area G) each year over 2005–2014 (ADF&G data). These anglers, on average, expended 41,800 angler days (range 32,570–52,600 angler days) of fishing effort. Daily Glacier Bay Proper vessel entry limits (i.e., 6 charter and 25 private vessels) during the June through August period reduce recreational marine fishery access and crowding during the summer months.
Sport Fishing – Freshwater	Quality and range of opportunities	⇔	Freshwater anglers target primarily coho and sockeye salmon, but also Dolly Varden char, pink salmon, chum salmon, cutthroat trout, rainbow trout, and steelhead trout. A general prohibition on guided freshwater fishing for permitted concessions operators exists with an exception for four lodge operators in the Preserve and two pre-ANILCA historical operators on the Dundas/Seclusion River. Over the most recent ten year 2005–2014 period, over 860 anglers on average (range 520–1,304) reported fishing freshwaters within the Glacier Bay area (Area G) each year (ADF&G data). These anglers, on average, expended 2,200 angler days (range 1,500–3,160 angler days) of effort each year. Daily Glacier Bay Proper vessel entry limits reduce on-stream access and crowding. Streams near Gustavus, Bartlett Cove and in Dry Bay are also accessed on foot, OHV and via non-motorized watercraft.

Recreational Opportunities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Commercial Services	Quality and range of visitor opportunities		The range and number of commercial services available in GBNPP has remained consistent. Services available are managed under 2 types of permit systems. There are currently 35–40 operators under Commercial Use Authorizations (CUAs) providing 14 different service types (e.g., Air Taxi, Hiking, Mountaineering), and there are 40 Concessioners Permits providing 9 different service types (e.g., Lodging, Tour Vessels, Charter Vessels, Cruise Ships). Most visitors experience Glacier Bay NPP using one or more of the available concessions. Restructuring and simplifying of this organizational system, as well as reducing the number of operators, would be beneficial to the park to make sure commercial services are aligned with park fundamental values such as wilderness preservation and minimal resource impacts. Management is concerned that the CUAs have allowed for things to happen in the park not consistent with fundamental resources and values. Also, due to the lack of competition, the park feels that service is not at a standard that it should or could be. There is perception that some operators don't care about the facilities or providing quality service.
Frontcountry Accommodations	Quality and range of opportunities		Opened in 1966, the Glacier Bay Lodge is the only lodging facility in Bartlett Cove and the only lodge accessible by vehicle. Although a significant representation of the historic "Mission 66" style, the facility is in drastic need of repair, maintenance, and updating. The facilities, managed by a third party concessioner, have been allowed to deteriorate greatly over the years while rates have increased. Over the past 3 years, the Glacier Bay Lodge occupancy has gone up from 54% in 2013 to 70% in 2015. The nearest accommodations outside of the park are within the adjoining community of Gustavus. These accommodations are mostly Bed and Breakfast type services. All (including the Glacier Bay Lodge) are high priced, and make it financially infeasible for many families to afford visiting the park. There is no variety of food service options within the park. The only option is the restaurant in the lodge, and currently there is no "grab and go" service or "camper store" to obtain quick food items or snacks. There are a few additional options in the adjoining community of Gustavus, but the logistics of transportation for visitors to get to town is not convenient since most visitors are without their own vehicles. Overall visitor satisfaction with commercial services in the park has remained consistently between 73% and 82%. A new contract began October 1, 2015. *Sources: GPRA Visitor Survey, Commercial Use Data*

Recreational Opportunities (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Trail Experience	Quality and range of opportunities		The majority of the park is undeveloped. The Bartlett Cove area has three designated trails covering 12 miles. Management has identified an interest in increasing the trail system in future years to provide additional hiking opportunities. A variety of improvements have been completed (new boardwalks, waysides, trailhead signs, surfacing, etc.), and the Towers Trail was re-opened to bicycles in 2012. Maintaining trails in the rainforest environment to meet visitor needs and to prevent unnecessary resource impact continues to be extremely challenging. In recent years, an increase in off-vessel tour boat hiking (≈2,000 passengers/summer) has raised concern for possible impacts in specific high-use areas. Glacier Bay NPP has not formally monitored social trails and a management plan for backcountry trails is needed. The developing Frontcountry Plan for Glacier Bay describes the extensive problems with the trail system and the need for an entirely different approach to address visitor experience needs, changing vegetation due to succession and uplift, and trail maintenance problems.

Accessibility

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Mobility	ADA compliance		Tour boats and cruise ships provide tremendous park access to 95% of park visitors. These ships are all ADA accessible. In Bartlett Cove, the Forest Trail boardwalk, with corresponding waysides, the public dock information node, and new campground comfort facilities are accessible. There are some available wheelchair accessible tables and facilities. The Tribal House is accessible.
Visual Accommodation	Accommodation		Cruise ships and tour boats provide Glacier Bay NPP experiences and support for all passengers with a wide range of abilities. Many hands-on displays provide connections, such as 3D relief maps. Visitor Center displays on cruise ships include tangible items such as pelts, silt, teeth, claws, etc. Information in Braille is now available. Many of the park's online materials do not meet accessibility guidelines. The park is working to improve these deficiencies.
Auditory Accommodation	Accommodation		Glacier Bay NPP has employed sign language qualified interpretive seasonal staff during the past 15 years. Scripts of ranger programs are made available. The park online videos are captioned, yet the park orientation films are not yet captioned. The park's visitor center theater and Visitor Information Station is not set up to provide auditory assistance and captioning.

Accessibility (continued)

web

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Public Transportation	Access to park via public transportation	↑	New Alaska Marine Highway System (ferry) service to Gustavus is now available. Visitors can visit the park with their own vehicles.
Multi-lingual Resources	Audio and print materials in multiple languages Bi-lingual staff	↑	The park brochure is available in 7 languages, and a series of "Ranger Minute Welcome" videos are available online in 5 foreign languages. To assist our international visitors, Glacier Bay NPP interpretive staff are hired with multiple language abilities (Spanish, French, German, Italian, and Japanese in 2015).

Safety

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Visitor Safety	Number of incidents	↔	The park works to identify and mitigate potential hazards, resulting in a low number of reported visitor accidents. The park Visitor Information Station provides vessel and backcountry use orientations, safety briefings, and provides free bear canisters for visitor use while visiting the park. Visitor medical assistance and rescue is provided by the NPS in partnership with Gustavus Fire Department, AK State Troopers, and the U.S. Coast Guard.
Visitor and Resource Protection	Ability to respond effectively	↓	Remoteness of the park makes access difficult. The ability to respond to emergencies is reduced due to lack of appropriate size vessels to access the outer coast and no current park aircraft. Park has two current Law Enforcement Ranger vacancies, which is 40% of its workforce. This has resulted in reduced availability of staff scheduling coverage, and directly affects the ability to respond to emergency calls for service in a timely manner. Park has instituted a 24-hour year round emergency dispatch service with Alaska Region Communications Center. Park protection staff is actively engaged in law enforcement patrols within marine waters and land. Case incidents are reported through the NPS Incident Management Reporting System and the Alaska Regional Communication Center. The park has current emergency response agreements with U.S. Coast Guard, AK State Troopers, NOAA (fisheries enforcement), Homeland Security, Gustavus Fire Dept. AKDOT, and other Department of the Interior agencies including the BLM and USFWS. The park internal incident communication system is reported through a park radio center and tracked by a computer added dispatch (CAD) program.

Safety (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Staff Safety and Training	Number of staff trained	⇧	NPS Operational Leadership Training has been completed by all park staff. An all employee "Safety Day" is held at the beginning of each summer season and serves as an orientation and refresher to a number of key safety topics. Job Hazard Analysis is conducted before jobs throughout the park. Formal training and written plans are required for higher risk talks such as working at height or within confined spaces. The Park Safety & Health Committee allows for active engagement from employees in park safety issues. Safety messages are distributed regularly to staff members.
Spill Prevention and Response	Ability to respond effectively	⇧	The park maintains an interdisciplinary team capable of rapid response to spills on land and in the water. Through contract, the park retains an Oil Spill Response Organization for same-day response that may transition into a lengthier response, as needed. The park holds annual hands-on spill response drills in collaboration with the U.S. Coast Guard and the AK Department of Environmental Conservation. The park also works to collaboratively provide and maintain spill response gear with these agencies.
Active Geology Hazards	Earthquakes, Landslides, and Tsunamis	⇔	There is moderate concern about potential threats from earthquakes, landslides and tsunamis to the safety of park visitors in the upper portions of Glacier Bay. Seismic activity in and near the park is high, with the Fairweather Fault running through the park, and at least five earthquakes with a magnitude of 7.0 or higher have been recorded in Yakutat to the northwest of the park in the last century (Yehle 1979). Earthquakes large enough to cause damage are rare. In the last few years, several large landslides have occurred in remote areas of the park high in the Fairweather Range; these were not induced by seismic activity and may have been caused by melting permafrost, glacial debutressing or other contributing factors. A large potential rock avalanche has been identified above the northern shore of Tidal Inlet in Glacier Bay. Field surveys and subsequent modeling indicate that a slump of between 5 and 10 million cubic meters moved on this site between 1892 and 1919 (Wieczorek et al. 2003). While there is no evidence of current significant slope movement at the site, there is concern that an earthquake along the nearby Fairweather fault system could trigger a massive slope failure and debris avalanche into Tidal Inlet, resulting in hazardous waves (Geist et al. 2003), occurring in areas far from park infrastructure but near where significant boat activity takes place. Although large alpine landslides in the high Fairweathers appear to have increased in frequency in recent years, the lower-elevation events have not—hence the unchanging trend. These landslide dynamics have been observed anecdotally and opportunistically, and have not been rigorously monitored, so we have medium confidence in the assessment. The last known significant tsunami in the park (in this case a landslide-generated giant wave) occurred in 1958 (Miller 1960). These are very low-probability but potentially high-consequence events.

Safety (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Active Geology Hazards (continued)	Glacial Outburst Floods		There is moderate concern about potential threats from glacial outburst floods to the safety of park visitors in remote areas of the park. Glacier-dammed lakes can form when glacial ice along the main stem of a glacier blocks streamflow from a tributary valley. When the lake becomes large enough, it may force the ice dam to become buoyant, which results in a rapid emptying of the lake and a catastrophic outburst flooding (Post and Mayo 1971). The large volume of water released during these flood events can eliminate vegetation and trees, deposit vast amounts of sediment lower in the watershed, cause the river channel to be relocated, and potentially be hazardous to humans and damage infrastructure in the immediate area. Glacier-dammed lakes occur in several places in the park (Capps and Clague 2014). At present, no park infrastructure is threatened by glacial outburst floods, and known glacier-dammed lakes occur in areas of low visitation. Importantly, the moderate concern about the condition of this measure is based upon the potential threats from them to the safety of park visitors in remote areas of the park. These events have been observed anecdotally and opportunistically, and have not been rigorously monitored, so we have medium confidence in the assessment. These are very low-probability but potentially high-consequence events.

Resource Brief: A Floating Ranger Station!

Glacier Bay NPP ranger patrol staff regularly utilizes a unique facility in Glacier Bay. The tiny ranger station is towed to South Sandy Cove and anchored in the sheltered inlet where it serves as a fantastic base of operations up-bay during the busy summer months. With bunks, a propane stove and fridge, supplies, and park radio, the raft operates as a temporary living facility for staff to conduct routine patrol efforts for up to a week at a time. This allows for staff to respond to service calls and emergencies in the upper bays of the park in a timely manner opposed to responding from Bartlett Cove, which is over an hour and a half further away by vessel. This floating "home away from home" also supports research operations and up-bay maintenance activities.

Home away from home in Glacier Bay. NPS Photo.

Partnerships

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Volunteers	Number and hours contributed		All park divisions continue to benefit from the work of volunteers on a variety of projects. In 2015, 92 volunteers contributed 2,703 hours. Volunteer opportunities are limited by housing options and remote location. *Source: Annual VIP Reports*
Partnerships	Quantity and quality of partnerships		Glacier Bay has meaningful and effective partnerships working with a wide range of official and unofficial partners to accomplish various goals and strengthen the connection between the park and community. The natural and cultural resource programs work with multiple universities and through interagency partnerships to accomplish a wide range of projects, including those resulting from International Partnerships.

Scenic Resources

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Scenic Views	Scenic Views Quality & Protection		Glacier Bay is a place of superlative scenery, and a highlight of Alaska's Inside Passage. High Fairweather summits, dynamic glaciers, scenic fjords, and extensive distant views of islands and shorelines remain a prime attraction for visitors, and have been identified as primary reasons for visiting. Remote and wild, the views enjoyed by park visitors are protected as part of the park in all directions.

2.4. Park Infrastructure

Overall Facility Condition Index

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The National Park Service uses a facility condition index (FCI) to indicate the condition of its facilities and infrastructure. FCI is the cost of repairing an asset, such as a building, road, trail, or water system, divided by the cost of replacing it. The lower the FCI number, the better the condition of the asset. The condition of the buildings and other infrastructure assets at each park is determined by regular facility inspections, or "condition assessments," including daily informal inspections and formal yearly inspections. Deficiencies identified from these assessments are documented in the NPS Facility Management Software System and the cost for each repair determined. Repairs that cannot be completed within the year count against the condition of a structure. The total cost of these deferred repairs divided by the total cost to replace the structure results in the FCI, with values between 0 and 1 (the lower the decimal number, the better the condition). The FCI is assigned a condition category of Good, Fair, Poor, or Serious based on industry and NPS standards. Deferred maintenance projects that require additional funding are identified based on FCI. Planned preventive maintenance on critical components occurs during the year, using a park's base budget. For additional information about how park managers use information about the condition of facilities and infrastructure to make decisions about the efficient use of funding for maintenance and restoration activities at the park, Click Here.

Asset Category	Number of Assets 2010/ 2015	FCI 2010/ 2015	Condition Status/Trend	Rationale
NPS Buildings	122 / 126	0.058 / 0.067		Buildings at GBNPP are in fair condition. In the last 5 years, 4 buildings have been added to the database and some building values have been reappraised. FCI data is not completely representative of building conditions, as some structures in need of repair or maintenance have not had cost estimates associated with these repairs completed or entered into the system.
Concession Operated Buildings	26 / 26	---- / 0.063		Concession operated buildings at GBNPP are buildings that are owned by the NPS, but currently leased for use by contracted vendors. Concession facilities at GBNPP (primarily the Glacier Bay Lodge) are in poor condition, and there is a large backlog of deferred maintenance needs. FCI data is not completely representative of building conditions, as some structures in need of repair or maintenance have not had cost estimates associated with these repairs completed or entered into the system. Reappraisal of building values applied to the database between 2010 and 2015 ($6.3M less value) makes the dollar amount of maintenance needed appear to be less, but the amount of physical work needed remains unchanged.
Campgrounds	2 / 2	0.286 / 0.000		Campgrounds in GBNPP are in fair to good condition. Drainage issues on access trails and tent pad area. FCI data in the FMSS database may be erroneous, with $420,000 in maintenance needs identified in 2010 (Bartlett Cove Campground), but that need erased in 2015, with no actual maintenance completed.
Frontcountry Trails	20 / 20	0.053 / 0.053		Frontcountry (Bartlett Cove) trails are in fair condition. Boardwalks have been added to a portion of the Forest Loop Trail. Condition assessments are needed to determine the costs of needed maintenance on park trails.

Overall Facility Condition Index (continued)

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Asset Category	Number of Assets 2010/ 2015	FCI 2010/ 2015	Condition Status/Trend	Rationale
Dry Bay Trails	22 / 24	---- / 0.008		Dry Bay Trails are in fair condition. Two existing trails were added to the database between 2010 and 2015. Thorough inspections of the trails have not been recently completed. Condition assessments are needed to determine the costs of needed maintenance on park trails. FCI data in the FMSS database may be erroneous; with identified trail maintenance needed costing $350,000 in 2010, missing from the database in 2015, without any major work completed. ATV/OHV use may be impacting these remote trails. Dry Bay trail maintenance is a lower priority for the park than frontcountry trails with heavier use.
Wastewater Systems	7 / 7	0.033 / 0.009		4 of the 7 wastewater systems at GBNPP are located in remote locations, while 3 provide water for majority of park operations. A formal inspection and condition assessment is needed to determine the amount of maintenance needed for these systems. Recent maintenance work fixed the failing waste water system located at the Indian Point office.
Water Systems	7 / 7	0.016 / 0.011		4 of the 7 water systems at Glacier Bay are located in remote locations, while 3 provide water for majority of park operations. A formal inspection and condition assessment is needed to determine the amount of maintenance needed for these systems.
Unpaved Roads	11 / 11	0.104 / 0.208		The majority of the unpaved roads and parking areas are service and maintenance areas with NPS buildings, and the park has submitted funding requests to improve them.
Paved Roads	6 / 6	0.104 / 0.294		The road into the park and parking areas are in poor condition due to improper chip-seal application, and the park has submitted funding requests to repair them.
Docks	4 / 4	---- / 0.016		Dock maintenance is critical in the harsh marine environment. GBNPP has 4 boat docks: Fuel Dock, Main Public Dock, Inner Lagoon Dock at Park Headquarters, and the Indian Point Pock. Recent maintenance was completed for the Inner Lagoon dock. FCI data in the FMSS database is erroneous; with identified dock maintenance on the Public Dock needed costing $39,000 in 2010, missing from the database in 2015, without any major work completed.
Marine Vessels	16	N/A		The Park used to have access to two all-weather ocean capable large vessels that were lost due to age and agency transfer over the last decade. These vessels were not replaced. Small vessel capacity has increased, but not enough to meet all needs. Marine vessels are not captured in the FMSS database.

Overall Facility Condition Index (continued)

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Asset Category	Number of Assets 2010/ 2015	FCI 2010/ 2015	Condition Status/Trend	Rationale
All Others (Waysides, Fuel Systems, Power Generation, Recycling, Airstrips, etc.)	27 / 28	0.021 / 0.008		There are a large number of items that are contained in this category including airstrips, power generations systems, internet systems, and radio communication systems. Park airstrips are in generally good condition. Power generation systems are working, but have unquantified maintenance and optimization needs. Internet infrastructure could be improved. Radio systems are structurally deficient, but repair costs for this system have not be quantified and entered into FMSS.

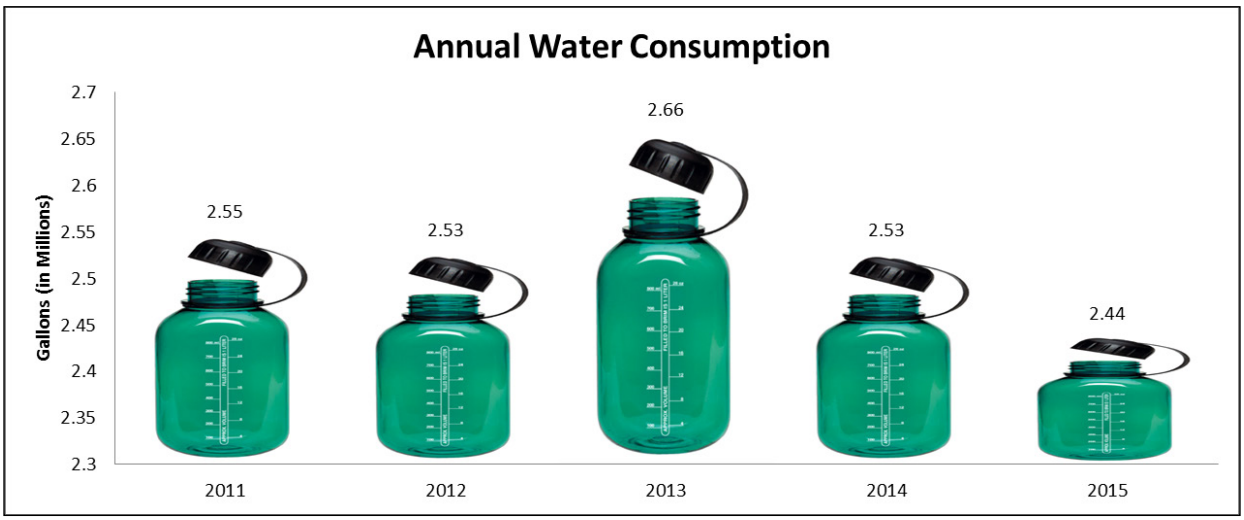
Resource Brief: "Greening" the Park – Energy, Water, and Recycling

The NPS manages the largest number of constructed assets of any civilian agency in the Federal Government. It operates more than 67,000 structures that account for more than 50 million square feet of constructed space such as visitor centers and historic structures. The Green Parks Plan (GPP) defines a collective vision and a long-term strategic plan for sustainable management of NPS operations. A critical component of the implementation of the GPP will be informing and engaging parks' staff, visitors, and community partners about climate change and sustainability to broaden opportunities to foster change.

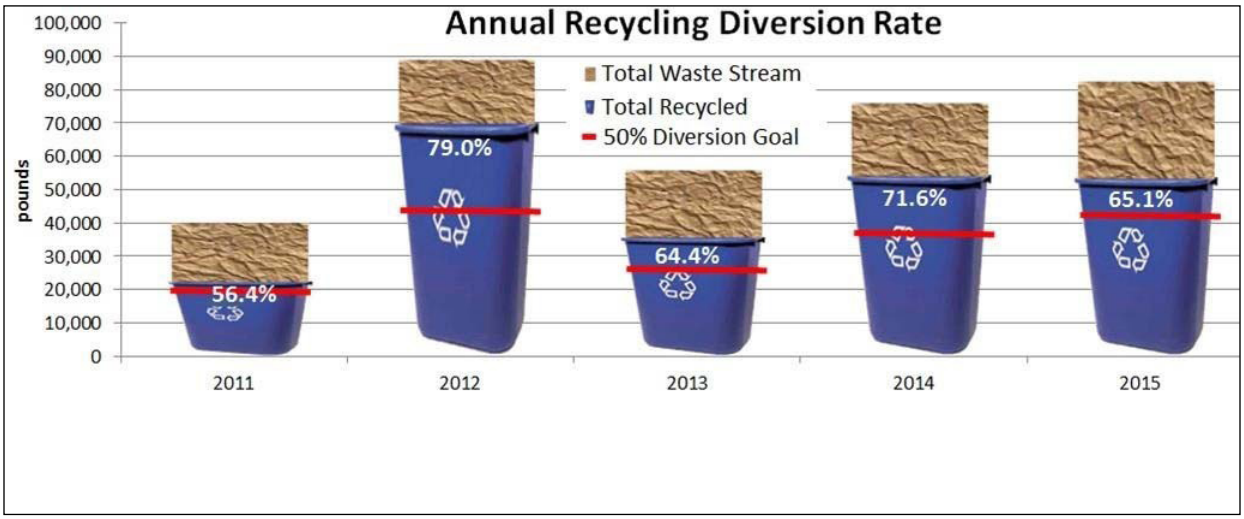
The Vision defined in the GPP plan is, "The NPS will preserve park resources unimpaired for the enjoyment of current and future generations by reducing its environmental impact through sustainable operations, design, decisions, and management at every level of the organization." The plan is based on nine strategic goals that focus on the impact of facilities on the environment and human welfare. Two of those goals are closely aligned with Park Infrastructure as defined in this State of the Park report. Those are:

- Be Energy Smart: The NPS will improve facility energy performance and increase reliance on renewable energy; and
- Be Water Wise: The NPS will improve facility water use efficiency.

Executive Order 13514 requires that Federal agencies promote pollution prevention and eliminate waste through improved recycling efforts. It requires agencies to minimize waste generation through source reduction and by the end of FY 2015 divert at least 50% of non-hazardous and 50% of construction and demolition debris.



Resource Brief: Greening" the Park – Energy, Water, and Recycling (continued)



Sustainability

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Electricity	Energy Intensity		Confidence of this rating is low due to inconsistencies in the way energy intensity measurement has been applied over the last ten years. A complicating factor for this measure is that park electricity is generated by park operated diesel generators. Due to generator inefficiencies, the measure of intensity is not as meaningful as the total amount of energy supplied or total amount of diesel used for power generation. The park is currently exploring the feasibility of an intertie to hydroelectric power as a possible long-term alternative to diesel power.
Water	Amount Used		Because the park is dependent on fluctuating ground water levels, a well system has been designed to supplement the existing system. Employees, concessioners, and visitors are notified whenever a major water supply reduction is anticipated. The park has identified a number of leaks in its water distribution system and is working to further investigate and repair piping.

Sustainability (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Recycling	Diversion Rate	⇧	The park's award-winning recycling program has already for several years exceeded the 2016 Federal Facility goal of a 50% diversion rate. For the future, the park is not focused only on improving recycling rates but also in reducing the total amount of its waste stream. In collaboration with the City of Gustavus, the park consolidates shipments of recyclables and shares resources. Through this collaboration, the City turns park food waste into usable compost. The park reduces shipping and disposal costs by processing chemical containers in-park and sending the containers as recycled scrap metal.

2.5. Wilderness Character

The Wilderness Act of 1964 requires the NPS to maintain Wilderness character, including the qualities of being "…untrammeled by man…undeveloped…natural," and allowing for "…solitude or primitive and unconfined recreation." A summary of wilderness character for the park is summarized below.

Overall Wilderness Character

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Wilderness Quality	Condition Status/Trend	Rationale
Natural		In general, the most significant threat to the natural quality of GBNPP's Wilderness is climate change. Among the most proximate threats to terrestrial systems are invasive plants. Invasive plant presence appears to be primarily limited to beaches of lower Glacier Bay proper and immediately adjacent uplands, thus impacting a small proportion of the Wilderness. Ocean acidification is known to be occurring in park waters, but its effects—while potentially significant and widespread—are only beginning to be understood. Additional changes to the natural quality that are driven by human activity are by definition negative. Local-scale drivers include warming air and sea temperatures and changing precipitation patterns (climate change manifestations), far-field contaminants, and the approach of a few species of invasive animals. However, there is limited information about these potential impactors as well as their effects, particularly in the context of the park's natural systems with wide ranges of natural variability. In some areas there are known impacts of local human activities such as vegetation/soil trampling and wildlife disturbance by visitors, but these disturbances are relatively restricted spatially and temporally, with no known population-level effects. There is the potential for a large contaminants spill (e.g., fuel spill) associated with marine vessels; this is considered a low-probability but potentially high-consequence event.
Undeveloped		To preserve the undeveloped character of the Wilderness, GBNPP has recently removed some defunct installations, and added others, resulting in a substantial reduction in the total number/net impact of these structures. Collectively, existing installations have a minimal spatial, visual, and auditory footprint.
Untrammeled		Trammeling (human activities that directly manipulate and control natural processes) continues to be very minimal in the park's Wilderness. For the past five years the NPS has annually treated with herbicide a single population of perennial sowthistle (an invasive plant) at a single Wilderness location in a program to eradicate it; in some other locations small numbers of invasive plants are removed manually by hand-pulling. These activities occur on very small proportions of the park's Wilderness.

Overall Wilderness Character (continued)

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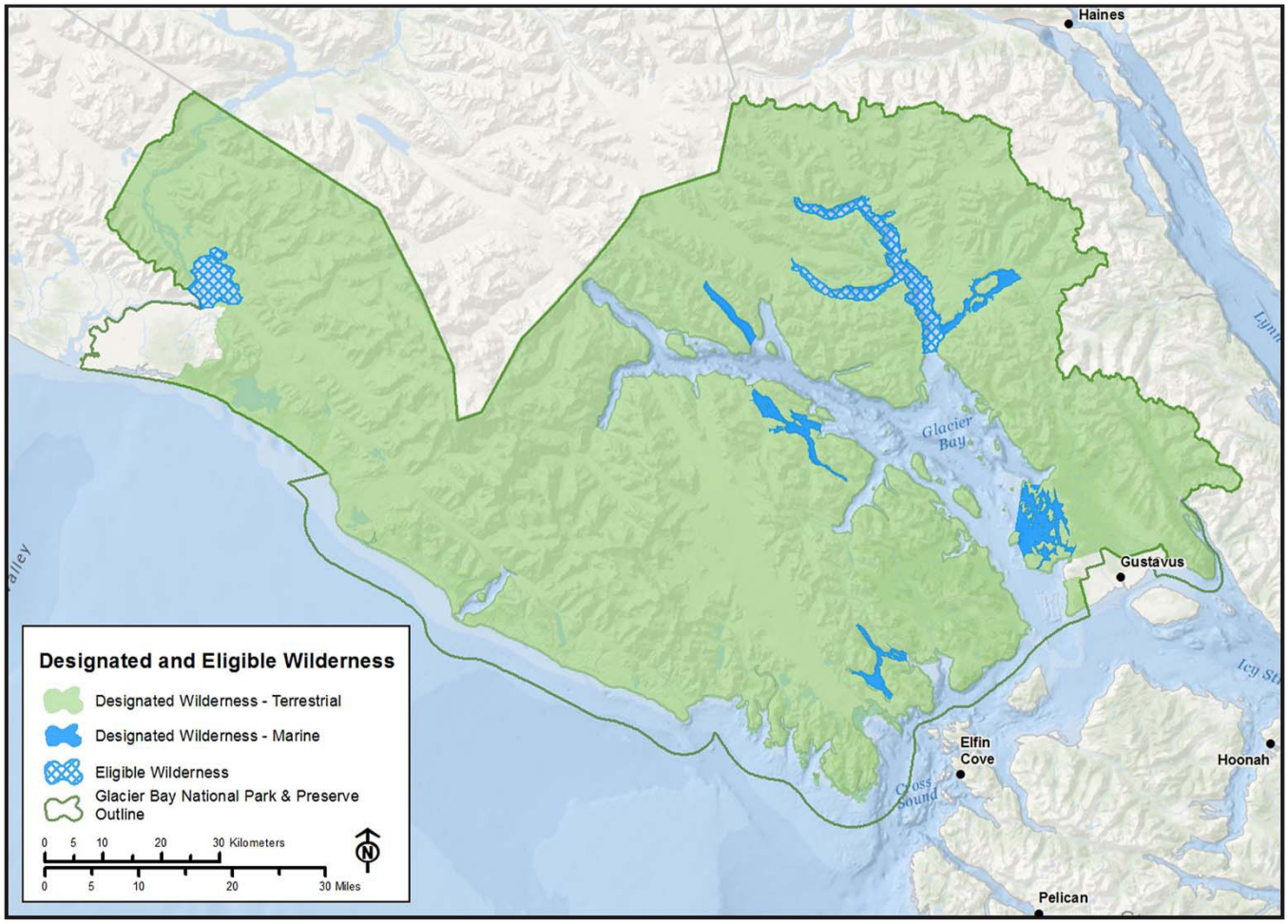
Wilderness Quality	Condition Status/Trend	Rationale
Solitude or Primitive and Unconfined Recreation Opportunity		By any measure, GBNPP's Wilderness is vast. Nearly all of GBNPP's land area (not including the 55,000-acre Preserve at Dry Bay) is designated wilderness. Additionally, approximately 48,000 acres of the park's marine waters are wilderness. The presence of humans, their works, and their activities are generally very sparse, low-magnitude, and/or are of short duration. The great majority of human use is concentrated along a very thin (generally 100–200 m wide) strip of marine shoreline in Glacier Bay proper; moreover, much camper use is concentrated near glacial attractions and near tour vessel drop-offs. The marine waters provide the principal access to the park's Wilderness. There is a single maintained trail in the Wilderness (adjacent to the park's non-wilderness frontcountry developed area). There are no backcountry amenities, and very few limits or restrictions on where Wilderness visitors can go. Active management of backcountry Wilderness visitors is minimal. Wilderness recreation in the park backcountry places a high premium on self-reliance.
Other Features and Values		Opportunities to study unique natural phenomena in the park are defined by enabling Proclamation as one of the principal reasons the Monument was originally set aside. In particular, research on glacial behavior and Glacier Bay's developing landscape and biological communities in the wake of glacial recession were considered key. Inasmuch as the park's Wilderness designation and ensuing management attempt to protect it from anthropogenic influences even as its natural dynamism and variability are preserved, Glacier Bay's value as a "natural living laboratory" becomes increasingly important in a human-dominated world. Park managers remain extraordinarily sensitive to this wilderness character quality, and work hard to ensure that opportunities continue. Some research projects are constrained by regulations intended to protect other wilderness qualities (e.g., seasonal prohibition of motorized access in order to protect the natural qualities above); other projects effectively and gladly design their projects to avoid conflicts.

Resource Brief: Marine Wilderness

GBNPP includes one of the largest (over 600,000 acres) federally protected marine ecosystems in the country (and the largest in the NPS). This includes nearly 1,200 lineal miles of wilderness coastline park-wide, half of which is in Glacier Bay proper. It also includes over 45,000 acres of specially protected marine "wilderness waters" and another 30,000 acres of marine waters deemed Eligible for wilderness designation.

Almost all park visitors come on cruise ships, and virtually all the rest similarly experience the park via some sort of boat, including sea kayaks. A quick look at the map shows that instead of roads, GBNPP has waterways. Most (not all) of these marine waters are non-wilderness, yet they are immediately adjacent to terrestrial wilderness, and they are the "highway" upon which visitors access the wilderness. In some ways GBNPP Wilderness seems remote indeed (far from population centers, and essentially roadless). In other ways, however, the park's spectacular Wilderness is remarkably accessible in so many places by way of its extensive marine roadway.



Designated and eligible wilderness within Glacier Bay National Park. Note the areas of designated marine wilderness, a unique feature within the wilderness preservation system.

2.6. Subsistence Use and Commercial Fish Harvest

Subsistence Use

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Subsistence harvest under Title VIII of ANILCA is authorized only within the 57,000-acre National Preserve, which is located in Game Management Unit (GMU) 5A. No federal subsistence is authorized anywhere within Glacier Bay National Park. There is very limited subsistence use in Glacier Bay National Preserve compared to other NPS units in Alaska. Historical year round residents were moved out of the area during World War II and the area was used seasonally for commercial fishing and hunting, and for fishing lodges in ensuing years. Yakutat residents are the only qualified subsistence users for most resources and often combine their commercial fishing activities with subsistence harvest of fish and other resources. Access is primarily by air taxi and Yakutat has no air taxi available from mid-October to mid-May at present. The primary resources harvested for subsistence are salmon, berries and moose.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Up-to-date documentation is available about subsistence resources and their uses in communities eligible to harvest resources in the park/preserve		Ethnographic and harvest surveys of subsistence use in the Preserve are fairly complete and recent, but unpublished. Annual tracking of subsistence game and fish harvest is done through in-season management of all commonly harvested species. In-season management consists of daily monitoring of moose harvest so as not to exceed the quota for the sub-unit. CPUE (Catch per Unit Effort) numbers are monitored daily to adjust the East Alsek River and Alsek River weekly openings and weekly aerial surveys of Salmon in the East Alsek River for the commercial fishery.
Opportunity and Continuity for Subsistence Activities	Proportion of users who are able to engage in all the subsistence uses they would like to pursue		A number of cabins and camps exist for the support of commercial fishing during the fishing season. They are not authorized for other uses (i.e., subsistence, public use, commercial purposes). The regulations and policy governing other uses differ in each category and do not allow additional uses of the structures. At this time, cabins are not fully utilized, indicating opportunities are not limiting. Aircraft-only access is a hindrance to subsistence access with no year round air taxi in Yakutat and increasing costs of getting to Dry Bay via aircraft. The Yakutat Public Use Cabin is open at no charge to residents for subsistence-only moose season.
	Subsistence users are engaged in subsistence management		The community of Yakutat has an ongoing high degree of engagement in subsistence regulation and management. A relatively high percentage of the community is involved.
Harvest of Fish, Wildlife, and Vegetation	Fish Resource Availability		Commonly harvested fish species in the East/Doame River System (king, sockeye, coho and eulachon) are available. Salmon are actively managed and appear to be stable in the preserve with good opportunities to people who harvest in Dry Bay. Eulachon populations also appear to be stable.
	Wildlife Resource Availability		Commonly harvested wildlife species (moose, waterfowl) are actively managed and appear to be stable in the preserve with good harvest opportunities for people in Dry Bay.
	Vegetation Resource Availability		Historical use of vegetation is poorly documented by ethnographic studies, and current uses are not well understood. Vegetation and fungus resources in the Preserve include, but are not limited to: strawberries, firewood, mushrooms, salmon berries and goosetongue.

Resource Brief: Subsistence Use

Most fish and game harvest under federal subsistence regulations are limited to residents of Yakutat and people residing in GMU Unit 5A residents only. Some of the major resources available for subsistence are bears (black and brown), deer, goat, moose, furbearers, ptarmigan, waterfowl, marine mammals, salmon, trout, halibut, crab, clams, berries and other edible plants (such as wild celery, ferns, and kelp), alder, spruce, and other wood resources. Access to the Preserve is almost completely by aircraft because of the hazard of taking a small boat along 60 miles of coastline in the Gulf of Alaska.

Subsistence harvest of moose occurs within Glacier Bay National Preserve. NPS Photo.

The vast majority of subsistence resources harvested in Glacier Bay National Preserve are salmon and moose. Salmon are taken with set gillnets in the East Alsek and Alsek Rivers usually with the same gear and skiffs used for commercial fishing. Access is normally by ATV to a net site or boat-landing site. A skiff is used to pull the net out and pick the fish, then the fish are transferred to an ATV for transport back to camp. Recorded harvest in the East Alsek River since 1989 has varied from 60 to 335 salmon with no record of harvest for eleven years in the period. The vast majority of the harvest is sockeye salmon with incidental catches of chinook, coho, chum and pink salmon. Most subsistence fishing effort occurs in the Alsek River adjacent to the preserve because the fish are higher quality.

Moose are taken under Federal subsistence regulation with a combined State/Federal registration permit. From October 8-21 the National Preserve (and all adjacent USFS lands) is open only to Yakutat residents for moose hunting. From October 22 to November 15, the season is open to all hunters. Annual harvest for the entire hunt has varied from one to eight animals since 1990 with the majority taken by Yakutat residents. Few Yakutat hunters use Dry Bay for moose hunting unless they have their own aircraft because of the cost and availability of a charter flight to the National Preserve.

In 2009, the NPS finished an Environmental Assessment that designated off highway vehicle trails and routes. Duplicate trails causing unnecessary resource impacts were closed. Total trail mileage went from over 90 miles to 61 miles. The process considered subsistence access as a primary use of the trail system and the NPS continues to improve conditions on the designated trails.

Recently, several commercial fishermen have become qualified subsistence users and have fish camps within the preserve. The camps are designated for support of commercial fishing only. The NPS has allowed subsistence use of the cabins on a case-by-case basis in the past, and is currently working on being consistent with other subsistence use of cabins across the region. To support subsistence users the NPS allows free use of the East Alsek Public Use Cabin during the moose season for Yakutat residents.

Commercial Fish Harvest

web

Commercial fishing is the harvest of fishery resources (fish and invertebrates) for sale and profit. National Park Service regulations authorize commercial fishing within Glacier Bay National Park. A Lifetime Access Permit (LAP) fishery within Glacier Bay Proper (GBP) enables qualifying fishers to participate in authorized fisheries until they are no longer able. Permits cannot be passed on or sold. Authorized fisheries include winter king salmon troll, Tanner crab pot and ring, and Pacific halibut longline. LAPs are renewed at 5 year intervals since 2000 when new regulations were first implemented. Based on LAP holder age, annual attrition rates and projected retirement age, very few participants are anticipated to continue fishing beyond the year 2050. Commercial fishing is authorized to continue in all park waters outside GBP with a prohibition on any new or expanded fisheries. Existing fisheries include those that were occurring at the time the commercial fishing regulations were implemented (1998/99). The superintendent will evaluate any expansion in fishery geographic or temporal scope or methods based on Alaska fishery regulations defining fishery specific parameters that were occurring prior to and during implementation of the initial 2000 regulations.

Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Knowledge	Up-to-date participation & harvest documentation is available		Despite the availability of multi-agency (ADF&G, IPHC and NOAA) electronic eLandings data, fisheries information access is often delayed. For example, some harvest is still reported using fish ticket hard copies and mailing timelines, review, follow up, correction, data entry and validation often delay information availability by several months or up to a year after fishery closure. Legal constraints, reporting metrics, and statistical area misalignment impose additional constraints. Alaska statute prohibits fisheries harvest information availability when three or fewer participants report landing within a specific area (e.g., scallop dredge, king crab and shrimp). Moreover, reporting metrics (e.g., lbs. vs. fish numbers) and statistical reporting area misalignment with the NPS boundary provide interpretation and analysis challenges. The lack of timely harvest and spatially explicit information as well as other data challenges potentially hampers park manager's ability to assess resource and visitor concerns. Park staff are developing an annual biomass removal summary for select species and establishing a standardized data transfer and work flow for summarizing and reporting this information.
Non-Target Species Commercial Fishing Impacts	Impacts from Longline fishing		Longline fisheries target Pacific halibut and other benthic fish species ("groundfish") primarily in outside waters, removing an estimated million plus pounds of targeted and bycatch fish biomass from park waters annually (unpublished IPHC data, Green et al. 2014). Baited hook and line longline gear is non-discriminatory and results in hooking, entangling and injuring or killing non-target species including fish, marine birds and marine mammals. Undersized halibut (< 32 inches) and other "non-retention" species (e.g., sablefish) must be released despite incurred injury and mortality. Bycatch effects can be significant. Groundfish and halibut fishery lingcod bycatch exceeds directed fishery removals (Green et al. 2014). Longlines cause marine mammal interactions, bycatch injury and mortality in Alaska (Allen and Anglis 2015, Read et al. 2006, Thode et al. 2007, Yano and Dahlheim 1995). Lost and derelict gear can also "ghost fish" when baited hooks attract and catch fish thereby subsequently rebaiting.

Commercial Fish Harvest (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Non-Target Species Commercial Fishing Impacts (continued)	Impacts from Crab/ Shrimp Pots		Crab and shrimp pot gear are authorized under king, Tanner, Dungeness crab and shrimp fisheries primarily in outside waters. These gear combined remove an estimated hundreds of thousands of pounds of invertebrate biomass from park waters annually (Hebert et al. 2008, Messmer et al. 2014, Smith et al. 2014, Stratman et al. 2014, various ADF&G unpublished data). Release injury and mortality effects can be incurred by undersized and female crab while entrapped and during topside sorting and handling especially under freezing winter conditions. Pot gear can also capture and retain small numbers of non-target species (i.e., other invertebrates, fish and some marine mammals). Marine mammals, particularly large whales, can become entangled in pot lines causing injury and mortality (Allen and Angliss 2015, Read et al. 2006, Johnson et al. 2005). Pot gear can also injure, remove and kill sensitive sessile epibenthic invertebrates (e.g., sponges, soft corals) during deployment and retrieval. Pot gear buoy lines occasionally become entangled in vessel propellers and under high current conditions may pose a serious safety hazard.
	Impacts from Trolling		Some presumably small but unknown component of non-target fish and other organisms are impacted by commercial salmon troll fisheries within the park. Released undersized Chinook (< 28 inches) and non-target species can incur injury or mortality as a result of physical stress. Especially fish species with closed swim bladders (e.g., rockfish) that suffer severe barotrauma when brought to the surface quickly from depth (Jarvis and Lowe 2008). Troll gear can hook and entangle marine mammals. Eighty-six percent of 196 sea lions that had ingested fishing gear or were hooked in the mouth exhibited a salmon flasher typically used in trolling during a 2000–2007 study in Southeast AK and British Columbia (Raum-Suryan et al. 2009). Interactions with killer and humpback whales has also been documented (Allen and Angless 2015). Groundfish bycatch in the Southeast commercial salmon troll fishery was reported at 32,800–71,400 round pounds annually during the 2010–14 period (Green et al. 2014).
	Impacts from Bottom Dredging		One or two scallop dredging vessels can harvest up to the 25,000 lbs. guideline harvest level of scallop meats annually from District 16, which encompasses at least two known park scallop spawning beds (Rosenkranz and Byersdorfer 2004). Each vessel drags two New Bedford scallop dredges weighing 2,600 lbs. each across benthic habitat, crushing, displacing and capturing scallops and various other epibenthic biota and infauna and altering benthic topography. The amount of this type of activity occurring in the park is unknown due to fishery confidentiality regulations. Published ecological assessments of dredging and bottom trawling activity elsewhere (Dorsey and Pederson 1998, Malik and Mayer 2007) suggest unacceptable habitat impacts, which may constitute impairment. (See also weathervane scallops).

Commercial Fish Harvest (continued)

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Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Opportunity to Harvest Fish and Invertebrates	Resource Availability: Dry Bay		Somewhat limited but relatively stable salmon and eulachon fisheries harvest opportunity exists under commercial, subsistence, and recreational regulations based on fishery season duration. The East River commercial sockeye fishery has periodically not opened (1999–2002, 2008 & 2010) due to an inability to achieve the current 13,000–26,000 sockeye escapement goal (Woods and Zeiser 2013). Moreover, productivity of the East Alsek/Doame River sockeye stock complex has declined significantly over the last several decades (Faber 2008, Heinl et al. 2011). High area uplift rates of ca. 30 mm annually (Larsen et al. 2005) have resulted in changing hydrologic conditions and reduced habitat quality and quantity (Faber 2008). Although overall stock productivity and fish abundance has declined, it remains relatively stable due to established escapement goals, commercial fishery openings of 3 or fewer days each week, and relatively limited subsistence and recreational removals. Commercial and recreational fisheries are likely becoming increasingly more reliant on smaller weaker stocks from other tributaries.
	Resource Availability: Glacier Bay Proper		Fair but declining fisheries resource harvest opportunity exists with more than 325,000 pounds of halibut, Tanner crab, and salmon removed annually on average over the last decade by commercial fishers. Resource availability and harvest opportunity is based on fisheries opening duration and a variety of specific NPS regulations including: grandfathered (diminishing) commercial fisheries for halibut, Tanner crab and salmon; designated marine wilderness, non-motorized waters, and other commercial fishery spatial and temporal closures. Salmon harvest opportunity has remained relatively stable, but halibut (IPHC 2015) and Tanner crab (Bishop et al. 2013) stock abundance has declined and fishers are experiencing reduced harvest as a consequence of reduced harvest allocations. While the park has concerns about the underlying ecological processes that may be associated with decreased harvest numbers, from the perspective of individual LAP holders there is now less competition with attrition and the legislative purpose of the program is being met.

Commercial Fish Harvest (continued)

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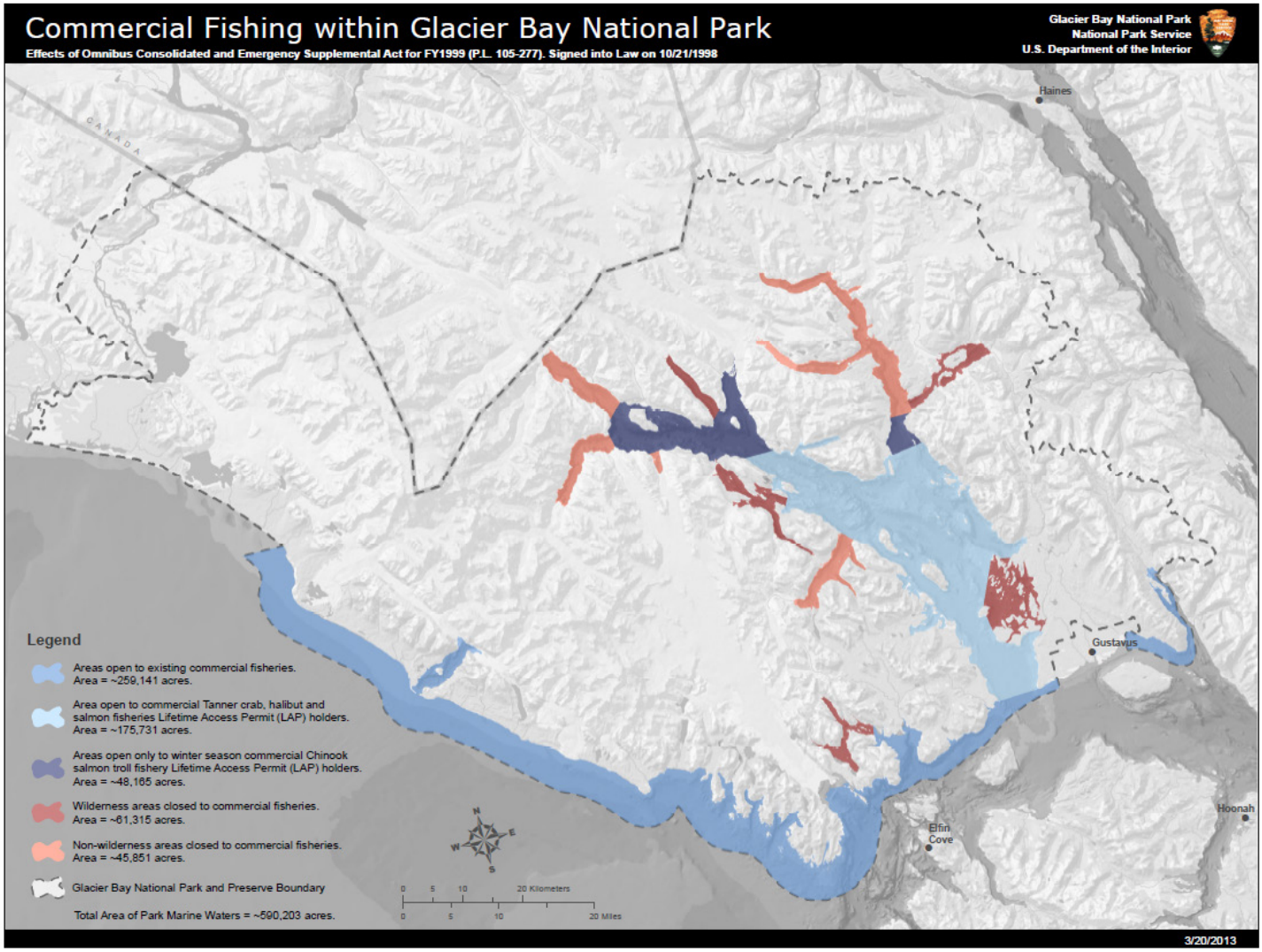
Indicators of Condition	Specific Measures	Condition Status/Trend	Rationale
Opportunity to Harvest Fish and Invertebrates (continued)	Resource Availability: Outer Waters	⇩	Resource availability and harvest opportunity is based on fisheries opening duration and, with two exceptions, there are few outer waters access limitations. The first is that no new or expanded commercial fisheries are authorized. Commercial fisheries authorized to continue since the time final regulations were implemented in 1999 include: king crab pot, Tanner crab rings and pots, Dungeness crab pots, weathervane scallop dredge, shrimp pots, Pacific salmon hand and power troll, chum salmon purse seine, Pacific halibut longline and groundfish dinglebar troll, hand and power troll and longline. Spatial or temporal commercial fishery expansion or the use of new gear or technology is prohibited subject to Superintendent discretion. The second access limitation prohibits commercial fishing in Dundas Bay wilderness waters. Overall, stock abundance and harvest has declined relative to historic levels. Some fisheries including king crab and shrimp, yelloweye rockfish in outer coast waters, and black rockfish in inside waters have been closed periodically or over the longer term due to low stock abundance. Salmon troll and chum purse seine, some groundfish species, Tanner and Dungeness crab, weathervane scallops and halibut remain at abundance levels adequate to support continued commercial fisheries harvest opportunities.

Resource Brief: Commercial Fishing in Glacier Bay National Park

Commercial fishing is the harvest of fishery resources (fish and invertebrates) for sale and profit. National Park Service regulations authorize commercial fishing within Glacier Bay National Park. Two regulatory approaches exist. The first, allows for a limited lifetime phase-out within Glacier Bay Proper (GBP). The second legally authorizes commercial fishing in park waters outside GBP indefinitely. Twenty (troll fishery) to almost 40% (Tanner and halibut) of waters within Glacier Bay proper are closed to commercial fishing, depending on the specific fishery (see map). In contrast, only 2.5% of outside waters (i.e., Dundas Bay wilderness) are similarly closed to commercial fishing.

Left: **Commercial Tanner crab LAP fishing vessel in Glacier Bay;** ***Right:*** **Example of pot captured Tanner crab.**

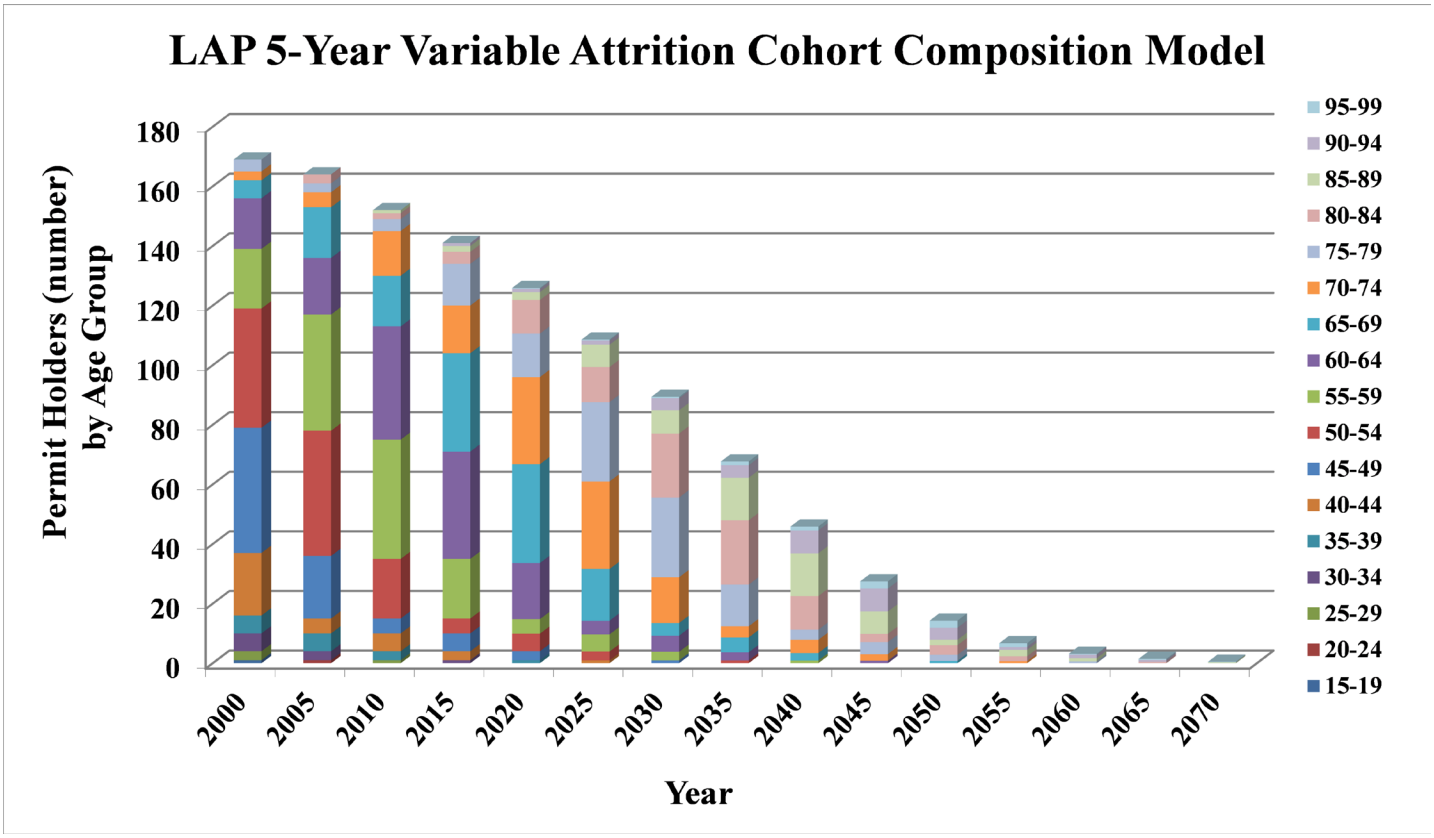
A Lifetime Access Permit (LAP) enables historically qualifying fishers to participate in three GBP authorized fisheries (i.e., Tanner crab rings or pots, halibut longline and salmon troll) until they are no longer able. Permits cannot be passed-on or sold. LAPs are renewed at 5-year intervals from 2000 when new regulations were first implemented. Based on LAP holder age, annual attrition rates, assumed longevity, and projected retirement age, very few participants are anticipated to continue fishing beyond the year 2050 (see figure). Lifetime Access Permit renewals in 2016 suggest that modeled attrition underestimates true attrition.



Commercial Fishing areas in GBNPP

Resource Brief: Commercial Fishing in Glacier Bay National Park (continued)

Commercial fishing is authorized to continue in all park waters outside GBP with a prohibition on any new or expanded fisheries. Existing fisheries include those that were occurring at the time the commercial fishing regulations were implemented (1998/99). The superintendent will evaluate any expansion in fishery geographic or temporal scope or methods based on Alaska fishery regulations defining fishery specific parameters that were occurring prior to and during implementation of the initial 2000 regulations.



Modeled LAP fishery attrition over time based on original age structure of fishermen and empirically based variable- age attrition rates for all fisheries combined.

Chapter 3. Summary of Key Stewardship Activities and Accomplishments

Activities and Accomplishments

The list below provides examples of stewardship activities and accomplishments by park staff and partners to maintain or improve the condition of priority park resources and values for this and future generations:

Natural Resources

- Collaborated on research projects addressing key management issues related to vessel operations in the bay with a number of outside institutions, including: vessel generated acoustic impacts on marine mammals, ship-whale interactions, vessel-based disturbance of seals and Kittlitz's Murrelets, and air emissions impacts from cruise ships.
- Completed draft of proposed regulation changes that would include more dynamic and relevant methods of implementing restrictions aimed at protecting wildlife.
- Continued to carry out long term monitoring of key indicators of Glacier Bay marine ecosystem, including oceanography (23 years), humpback whales (31 years), Kittlitz's Murrelets (7 years), and harbor seals (24 years).
- NPS Southeast Alaska Network (SEAN) implemented long-term monitoring of several key vital signs, including Water Quality, Marine Contaminants, Weather and Climate (as well as Oceanography and Kittlitz's Murrelets).
- Collaborated on research projects addressing impacts of climate change on Glacier Bay system with a number of outside institutions, including ocean acidification, glacier status and trends, hydrologic modeling, and availability of ice habitat for harbor seals.
- Completed Southeast Inventory and Monitoring Network (SEAN) long-term monitoring protocol development for the majority of key vital signs.
- Completed Natural Resources Condition Assessment report in cooperation with St. Mary's University to comprehensively summarize status of key natural resources, threats, and gaps in knowledge.
- Begun initial collaboration on a project to develop a structured decision making framework to address future decisions on closures and other restrictions that alter the behavior of visitors, commercial activities, and administrative activities within the park.
- Implemented new programs to increase communication and understanding between NPS and cruise ship pilots with the goal of protecting park resources, including: NPS staff involvement in Southeast Alaska Pilots Association meetings, distribution of whale sightings information for situational awareness (e.g., Whale Alert), shipboard observer program.
- Implemented changes to policy (commercial services conditions) and regulations (Park Compendium) related to commercial and recreational fishing to align current practices with intent of CFR regulations to increase protection of park resources.
- Completion of "Research Highlights" briefs for the majority of current research projects to aid in translating key research results to the general public and park managers.
- Conducted baseline surveys of glaucous-winged gull populations to inform future harvest of gull eggs by Huna Tlingit. Implemented experimental harvest of eggs to inform future harvest plan and logistics and enhance collaboration and participation by Huna Tlingit.
- Initiated large-scale planning projects for frontcountry and backcountry/wilderness regions of the park to aid in best management of park resources.

Cultural Resources

- After years of cooperative planning efforts, the Huna Tribal House (Xunaa Shuká Hít) was completed in 2016 and dedicated in August. The NPS continues to work with the tribal government, Hoonah Indian Association, to develop interpretive and operating plans for the facility.

- Over a six-year period, the park collaborated with the tribal government, Hoonah Indian Association (HIA) to design and carve key cultural elements for the Huna Tribal House. The carving project produced a house front, interior house screen, four house posts, and two totem poles. In addition to the production of elaborately carved treasures, the project provided opportunities for the transmission of traditional knowledge related to Northwest Coast arts and fostered a resurgence in cultural pride in the native community of Hoonah.
- Following years of research and collaborative planning, the park completed a Legislative Environmental Impact Statement and published a Record of Decision authorizing the harvest of glaucous-winged gull eggs by HIA tribal members pending required legislation and regulations. Legislation authorizing harvest was signed in 2014. Tribal members have continued to assist park biologist with research and monitoring efforts.
- As of 2016 there have been three large scale organized attempts to systematically inventory the cultural resources within GBNPP and two small limited scale survey efforts, totaling 146 sites. These efforts inventoried park lands for undiscovered archeological sites, re-documented previously identified archeological sites, assessed their conditions, and updated database records.
- Park staff partnered with Hoonah City School teachers and professional curricula developers to prepare a series of culturally responsive middle and high school level curricula focused on connecting Huna youth to their traditional homeland in Glacier Bay. Park staff team taught classroom curricula and implemented related field experiences in Glacier Bay homeland.
- To enhance communication and consultation between the tribal government and tribal members, two park staff (cultural anthropologist and management assistant) were duty stationed in the community of Hoonah, Alaska approximately 30 miles by air from park headquarters. These remotely stationed park staff serve as liaisons between the traditional community of Hoonah and Glacier Bay.
- Park staff crafted a new General Agreement between the NPS, HIA, and Alaska Native Voices Educational Institute (ANVEI; a non-profit arm of Huna Totem Corporation, the ANCSA village corporation for Hoonah) to facilitate cultural interpretation on cruise ships visiting Glacier Bay. The Agreements outlines a process by which cultural interpreters can board ships to convey the history and culture of the Huna Tlingit to visitors from around the world.
- For the Glacier Bay Lodge Complex Historic District, the park has initiated a substantial effort in addressing the deferred maintenance in all its associated historic structures.
- For 2016, park staff complied with federal laws, policies and mandates to insure that 54 separate undertakings were addressed and updated in PEPC, all ground altering activity monitored, and consultation took place with associated federal tribes, regional Native corporations, local governments, the State Historic Preservation Officer, and the general public.
- The Yakutat Tlingit Tribe (YTT), the Gunaaxoo Kwáan clans of the YTT, the U.S. Forest Service (USFS) and Glacier Bay National Park and Preserve (GBNPP) have worked collaboratively to document the ancestral homelands of these clans in the Dry Bay area. Beginning with Project Jukebox, to document place names on maps, to years of archeological surveys relocating these historic sites, this partnership came together once more in 2011 at Dry Bay. This planned celebration was to commemorate the lives of their ancestors, celebrate the discovery of remnants of the tribal houses, and to celebrate the Gunaaxoo Kwáan clans back in their ancestral land once again.
- Since 2007, the park has sponsored more than 50 Journey to Homeland trips, which convey tribal elders, youth, and other tribal members to Glacier Bay homeland to engage in cultural ceremonies, harvest berries and other traditional foods, and reconnect with special places. Trips are co-sponsored with partners HIA, Huna Heritage Foundation, and Hoonah City Schools.
- The park has partnered with University personnel to conduct research related to cruise ship effects on cultural resources.
- Park staff have completed, or assisted with, the preparation of numerous Traditional Cultural Property nominations.

Visitor Experience

- Personal services continue to be the proud centerpiece of our interpretation and education program at Glacier Bay. With our staff of five permanents, one term, and 26 seasonal employees, in 2015 we provided interpretive services and original programs to more than 500,000 visitors on cruise ships, tour vessels, and at Bartlett Cove. We also provided educational outreach programs that reached over 4,000 students, both locally and nationally and set in motion interpretive planning for the Tribal House project.
- Interpretation at Sea. Approximately 95% of Glacier Bay's visitors arrive on ships and tour boats, and park interpretive staff presenting meaningful and effective presentations on board the entire array of vessels (almost 500 vessels in 2015). Daily communications with all ship captains and collaboration with cruise directors and expedition leaders result in smooth interpretive operations on board.

- Glacier Bay's Junior and Explorer Ranger programs on board cruise ships continue to reach thousands of children cruising in Glacier Bay during the summer months. This program is enthusiastically embraced by on-board youth staff to enrich their programs for youth aged 3–16. Division staff spent time in each ship's children's center presenting special programs to the staff and youth. This year the park emphasized Teen programs with a ranger, using Facilitated Dialogue to engage the audience. Throughout the summer, rangers presented 276 Junior Ranger programs to more than 6,700 children and teens.

- Using the park's videoconferencing system, the division presented a series of long distance education programs to more than 2,665 students and 324 teachers in 18 different states and 1 Canada province! The park's green screen is a fabulous new venue for reaching youth (and others). We shared our success stories throughout the NPS Alaskan Region and worked with NPS Regional staff to secure funding for additional parks to present similar classes. Our Long-Distance program received the prestigious Pinnacle Award for the third year in a row from the Center for Interactive Learning and Collaboration based on excellent teacher evaluations of our programs!

- Accessibility Improvements include hardening of trails and campgrounds, rehabilitation of boardwalks, renovation of existing structures, and design considerations of new buildings.

- Glacier Bay NPP has chartered a multi-park safety program that incorporates Sitka National Historical Park, Klondike Gold Rush National Historical Park, and the Southeast Alaska Inventory and Monitoring Network. This allows the smaller parks access to a dedicated full-time safety professional to share expertise with their Safety Officers. Glacier Bay NPP's Safety Program earned the Director's Award for Employee Safety & Health Achievement, the highest level employee safety award in the National Park Service, for improvements to the park safety culture which resulted in major reductions in accident rates.

- Established partnership with West Norwegian Fjords World Heritage site and the UNESCO Marine World Heritage Program to promote Glacier Bay NPP's exceptional management of cruise tourism as an international model, to bring the partnership skills of the Norwegian parks to bear on Glacier Bay issues, and to jointly learn and enhance both park's interpretive operations.

Park Infrastructure

- In 2016, the construction of the Xunaa Shuká Hit (Huna Tribal House) was completed. The 2,500 square foot structure will symbolically anchor the Huna Tlingit in Glacier Bay, their ancestral homeland. It serves as a venue for tribal members to reconnect with their traditional homeland, life-ways, and ancestral knowledge; a focal point for conveying the story of the Huna Tlingit, their traditional life-ways, and their evolving relationship with the National Park Service to the visiting public; and a site for appropriate National Park Service administrative activities.

- The Park is nearly finished installing and commissioning an alternate water supply that will better position the Park in emergencies and in response to climate change. Instead of relying totally on a surface water source, the Park will now be able to rely on a water well as a primary or an alternate source of water.

- The Park has nearly completed converting all marine outboard engines to more efficient 4-cycle engines. This reduces the noise and pollution associated with two cycle engines. The new engines are less polluting and more fuel-efficient.

- The Park, based on recommendations for best management practices, contracted to have the Law Enforcement shooting range cleaned of lead contamination. Additionally, the majority of shooting was converted to a more environmentally friendly lead-free ammunition. Activities that require lead shot (qualifications) will now be limited to a newly installed bullet trap that will contain lead shot and keep the range free from lead contamination.

- Bartlett Cove internet capacity was increased to provide higher bandwidth for visitor, concessions, and administrative usage.

- The Park has added a number of electric vehicles to its fleet to offset the growing need for transportation. The Park charges these electric vehicles with excess energy created from the Park run generators. When the Park coverts to purchasing power from the local utility company, the effectiveness of charging electric vehicle will need to be re-evaluated.

- Generators were upgraded to provide more efficient power throughout the park.

- The Park water treatment system was redesigned to include nano-filtration. This provides park visitors, employees, and others with cleaner water, free of the disinfection by-products that had troubled the previous system.

- Major efforts have been realized with the install of fire sprinkler and alarm systems to high priority structures such as the Glacier Bay Lodge.

- The Bartlett Cove Inner Lagoon Dock and the Indian Point Dock floats have both been rehabilitated to ensure safe access by visitors, researchers, and employees.

- Fiberglass boardwalk grating has been installed throughout the park to replace wooden decking which had become slippery and costly to maintain and clean.
- The Park's incinerator was replaced with a more efficient model that uses less fuel.
- A roof structure was constructed to house a rearticulated whale skeleton on display for visitors.
- Dry Bay trails have been improved.
- Regular groundwater monitoring of a former fuel spill site in Bartlett Cove has resulted in the decommissioning of an Air Injection/Vapor Extraction system that had served to "off-gas" the spilled fuel to prevent the plume from migrating towards the waters of Bartlett Cove. The system succeeded and is now out of service.
- Campgrounds and trails in the frontcountry have been improved to allow for better accessibility.
- Vermi-Composting toilets have been installed in the Bartlett Cove Campground as an environmentally friendly means of processing waste in a location not connected to the park water distribution system.
- Expansion of the water system capabilities was completed with the addition of a well.
- Expansion of the waste water system was completed.
- As they near the end of useful life, appliances throughout the park have been replaced with energy efficient models.

Subsistence Use and Commercial Fish Harvest

- In-season commercial, sport and subsistence harvest monitoring of key species (salmon, moose and brown bear) by ADF&G, NPS and USFS within the Preserve.
- Consultation and collaboration with Yakutat Tlingit Tribe to get elders and youth to Dry Bay to learn and experience traditional practices and harvest. This culminated in the May 2011 Potlatch in Dry Bay with over 130 Yakutat Tribal members attending. A smaller elder and youth visit was supported in 2015.
- An OHV Environmental Assessment was completed to designate trails, provide subsistence access and reduce resource damage.
- Lifetime access permits (LAP) for qualifying commercial longline halibut, Tanner crab pot and ring, and winter Chinook salmon troll fishers have been reissued at five-year intervals since 2000. The NPS is in the process of finalizing and reissuing the remaining permits for the next five-year period (2016–2020). Observed LAP attrition is occurring at a higher rate than anticipated and very few permit holders currently engage in permitted fishery activity.
- A working definition of an "expanded fishery" evoking spatial and temporal constraints as defined in Alaska Statute at the time Public Law 105-277 was enacted (ca. 2000) was published in the 2016 park Compendium. No new or expanded fisheries are authorized in park outer waters (outside Glacier Bay Proper). Although there exists a list of fisheries occurring at the time regulations were established, no previous definition of an "expanded fishery" existed.
- Staff continues to track commercial, recreational and subsistence harvest removals from park waters and engage with other agencies (i.e., ADF&G, IPHC, NOAA and NPFMC) on a variety of fishery management legal and regulatory processes (e.g., charter halibut limited entry, allocation, sportfishing guide definition, halibut catch and release mortality, cessation of Excursion Inlet sea cucumber fishery).
- Provided funding and/or collaborative support for a variety of research projects investigating East Alsek River sockeye salmon productivity and habitat change (University of Alaska-Fairbanks), halibut movement (University of Alaska-Fairbanks), and Tanner crab stock abundance (ADF&G).
- Improved monitoring, outreach and permitting involvement for Ocean Beauty Seafoods, a seafood processing facility handling more than 10 million pounds of fisheries product annually and discharging processing waste into Excursion Inlet approximately 0.3 mile from the NPS boundary. Staff has conducted outreach efforts with children and adults, toured the facility, and reviewed and commented on the ongoing State of AK Department of Environmental Conservation shore-based processor permit revision and reauthorization process.

Wilderness

- Since 2010, GBNPP's Science-in-Wilderness Interdisciplinary Team has been evaluating all research proposals (internal and external) using the Science in Wilderness Framework (Landres et al. 2010).
- Similarly, GBNPP has been employing the Minimum Requirements Decision Guide to conduct Minimum Requirements Analyses of all proposed administrative activities that include Section 4(c) Wilderness Act prohibitions.
- In the last five years, GBNPP has developed a Wilderness Character Narrative and a draft Wilderness Character Monitoring Plan and Baseline Assessment.
- GBNPP is developing Extent Necessary Determinations for all commercial uses within Wilderness.
- The park is currently actively identifying and filling key information gaps in the run-up to the start of a comprehensive Wilderness Stewardship planning effort to begin in 2018.

Chapter 4. Key Issues and Challenges for Consideration in Management Planning

Glacier Bay National Park and Preserve has responsibility for managing natural and cultural resources of national significance to the American people. The unique marine jurisdiction and the nature of its organic legislation built around protecting an ecological process as well as access to the glacier environment provide special challenges. The park has experienced significant early conflict with Tlingit tribes associated with the park and with gateway communities over park establishment, restrictions on commercial fishing, subsistence, and vessel restrictions. The Park has achieved a notable level of preservation, improvements in visitor opportunities and relationship building over the last decades; however, significant challenges still exist.

Issue/Challenge #1

Increased ocean acidification and impacts on marine and terrestrial ecosystems

What is the issue?

Increasingly accelerated human burning of fossil fuels over the past two and a half centuries has increased the concentration of carbon dioxide (CO_2) gas in earth's atmosphere. As atmospheric CO_2 concentrations increase, some of the gas moves across the ocean-atmosphere interface and dissolves into ocean waters. The world ocean, including Alaska's coastal waters, is thus undergoing a process of "ocean acidification" (OA) with potentially wide-ranging effects on the structure and function of marine ecosystems. For example, OA has been shown to threaten the health of important marine organisms such as phytoplankton, shellfish, and larval fishes—and potentially the higher-trophic-level predators such as marine mammals and seabirds that depend on them for food. Moreover, park waters may be at even higher than usual risk of the negative effects of OA. Although dissolved CO_2 is a powerful "acidifier," seawater, by nature of its chemistry, possesses a relatively high "buffering capacity" to resist OA. However, this natural resistance is diminished in Glacier Bay because of increasing glacial meltwater runoff into the ocean due to global warming. This additional fresh meltwater dilutes the buffering capacity of the seawater, making it more vulnerable to OA and its negative effects.

What has the park done?

The park has conducted and/or hosted decades of research on physical and biological natural resources, and the NPS Southeast Alaska Inventory and Monitoring Network (SEAN) is halfway through a six-year program to install a network of eight long-term climate-monitoring stations across the park at multiple elevations. Both the park and the SEAN maintain rigorous long-term monitoring programs for key indicator resources expected to be responsive to warming temperatures, including glacial dynamics, streamflow, and landcover/landform. These programs are designed to detect long-term changes and trends in park resources, and the data are used to inform process-oriented studies to reveal their causes. In addition, the park/SEAN maintain a long-term oceanographic monitoring program that is well into its third decade, and the park is conducting cutting-edge OA research in partnership with the University of Alaska-Fairbanks School of Fisheries and Ocean Sciences. The OA research program is a carefully designed bottom-up approach to better understand how OA affects park resources.

What next?

The park continues to work in concert with other coastal NPS units, a variety of state and federal agencies, and several universities to better understand park environmental changes resulting from global warming and their likely future trajectories. While it is unlikely that the NPS alone—barring broad society changes—will be able to influence environmental warming, increased understanding may allow managers to develop response strategies as appropriate, while helping to ensure that attribution of observed resource impacts is properly assigned.

Issue/Challenge #2

Private vessel access including access by local communities

What is the issue?

The vessel quota system has been in place for almost two decades to good effect, providing superior experiences for the public and protecting park resources. The system has worked very well with a good balance of access by visitors aboard commercial vessels and private vessels. However, there have been relatively recent events that have created challenges with the allocation of private vessel entries that hinders the park's ability to provide a high diversity and high quality of visitor experiences, while maximizing the public's use of their national park balanced with protecting park resources. These events include the expiration of the exit and entry permit for

Bartlett Cove (despite the fact that the need still exists for this vessel activity) and increased use of the lower and mid bay for sport fishing (with the increase in sport fishing opportunity created by the phase out of the commercial fishery), which has caused increased competition for private vessel permits. In addition, changes in resources have occurred since the establishment of the vessel quota system, including changes in resource status (e.g., humpback whale endangered species status has changed), a more comprehensive understanding of the effects of vessels on marine resources, as well as new information on potential resource and visitor experience factors that were not major drivers in the past, but should be considered in allocation of private vessel entries.

What has the park done?

The large-scale reevaluation of the Vessel Quota System for all vessel types would require additional years of research and a large-scale planning process. The park has identified some opportunities within the existing Vessel Quota Environmental Impact Statement (EIS) that it could optimize the existing quota system providing some relief. The park has begun a regulatory package that would restore the flexibility of private vessel permit allocation within the Vessel Quotas. In addition, the park has started a frontcountry planning process that will identify the access issues and the ideas for solutions in the Bartlett Cove area, which along with the Lower Bay is where most conflict exists. Research has been conducted over the last two decades that can be used to minimize the effects of the smaller private vessels.

What next?

The park plans to fully identify opportunities within the existing Vessel Quota EIS to optimize the existing quota system. This would allow for a two stage process first optimizing entries under the previous Vessel Quota EIS which would provide the time necessary to conduct research and test alternative management strategies in preparation for an evaluation of the entire Vessel Quota System, which would take into account a range of park resources and values and utilize the research findings on effective mitigation. The park will submit the regulatory package in 2018 and will complete the Frontcountry Management Plan in 2018. The Frontcountry Management Plan (addressing some of the issues in the Lower Bay) as well as the Wilderness Stewardship Plan (addressing Wilderness waters), will provide opportunities for the park to address private boat issues while gaining knowledge of alternative management options. The park will be examining what information it will need to re-examine the vessel quota system as part of a Resource Stewardship Strategy, which is scheduled to be completed in 2018.

Issue/Challenge #3

Frontcountry facilities, recreational opportunities, and economic viability of commercial services

What is the issue?

The Glacier Bay NPP frontcountry area visitor facilities were established mainly as a way station for overnight guests before traveling to the glaciers. This function has been substantially supplanted by more economical cruise tourism as well as tour boats, resulting in poor performance of the Glacier Bay Lodge and increased deferred maintenance. With the establishment of the Huna Tribal House and scoping with the community, there has been the realization that there is an alternative vision of the frontcountry as a destination; a place where working with the Gustavus community we provide the opportunity for longer stay visitors to get a rich alternative experience to the tour and cruise ships. The current Comprehensive Design Plan was approved in 1998. It is outdated and many projects have been completed or superseded by changes in operational issues. Several administrative facilities have been outgrown or should be repurposed based on changes in commercial use and newly available utilities. Visitors have new options in how they reach and use the park, so use patterns and levels are changing.

What has the park done?

The park has begun a frontcountry planning process that will look at the Lodge, visitor facilities, trail network, camping, activities in the frontcountry as well as land and sea access. In 2016 the park conducted an extensive public input process with multiple meetings in gateway communities and outreach to the State, visitor associations, and other stakeholders.

What next?

The park will complete the frontcountry plan in 2018. Proposals will be created for the larger infrastructure changes in the NPS line-item construction process. The park will be conducting a robust outreach process with all stakeholders at each remaining step of the planning process.

Issue/Challenge #4

Commercial fishing and cooperative fisheries planning with the State of Alaska

What is the issue?

Section 123 of the Omnibus Consolidated and Emergency Supplemental Appropriation Act for FY 1999 directs the Secretary of the Interior and State of Alaska to cooperatively develop a commercial fisheries management plan for Glacier Bay National Park.

Cooperative development of a fishery management plan involving NPS, the State of Alaska and other relevant entities (i.e., International Pacific Halibut Commission, National Oceanic and Atmospheric Administration, North Pacific Fishery Management Council) would establish a relationship that outlines and respects individual and collective agency roles and responsibilities, promotes open dialogue, incorporates public involvement in the decision making process and implements Section 123. Further, it would recognize and clarify agency mandates and provide a process for resolving issues where NPS and State goals are in conflict. Without this plan, it is difficult to address issues of potential impairment by some fisheries (e.g., scallop dredging).

What has the park done?

Commercial fishing has long been an important issue at Glacier Bay National Park. Although NPS regulations have prohibited commercial fishing since 1966 and the Wilderness Act prohibited commercial fishing in wilderness waters since 1980, it wasn't until 1999 that legislation passed to definitively close all park wilderness waters as well as specifically identified areas of non-wilderness to commercial fishing. The legislation authorized continued commercial fisheries in outside waters that were in effect at the time. This legislation, Section 123 of the Omnibus Consolidated and Emergency Supplemental Appropriation Act for FY 1999, followed nearly a decade of attempts to resolve the commercial fishing issue through litigation and completion of a Commercial Fishing Environmental Assessment (1998).

The call for the development of a management plan for the regulation of commercial fisheries within the park, consistent with protection of park values and purposes, declares a prohibition on new or expanded fisheries and seeks to ensure opportunities for the study of marine resources. Progress on developing a plan was initially stalled over a legal jurisdictional dispute with the State of Alaska regarding submerged lands within the park. The Supreme Court ruled in favor of the NPS, granting federal jurisdiction over submerged lands and waters in 2005. In addition to continued fisheries monitoring and an improved understanding of fishing activity and State management in park waters, NPS established a recurring compendium listing of authorized outer waters fisheries beginning in 2003, convened a one-day workshop to define desired future fisheries conditions in 2013 and developed a working compendium definition for "expanded fisheries" in 2016.

What next?

The State of Alaska has recently agreed to engage with NPS to cooperatively develop the requisite fisheries management plan. The NPS has outlined a proposed scope, complexity and content for the fisheries management plan and is ready to work collaboratively with the State of Alaska to get their feedback and perspective on plan development.

Issue/Challenge #5

Deficiencies in the Glacier Bay park-specific regulations

What is the issue?

In July 2014, President Obama signed the Huna Tlingit Traditional Gull Egg Use Act (P.L. 113-142) into law to authorize the harvest of glaucous-winged gull eggs by the Huna Tlingit in their traditional homeland of Glacier Bay National Park. Gull egg harvest by members of the Hoonah Indian Association (the federally recognized tribe of the Huna Tlingit) may begin as soon as the Secretary of Interior promulgates federal regulations and a harvest plan is implemented. Since the last review of 36CFR, a number of issues have been identified, including the applicability and enforceability of some regulations, redundancies, and ambiguity related to identifying areas and resources. Thus, in reviewing 36CFR Part 13 the park leadership team identified some regulatory language that requires clarification necessary to protect park resources while providing consistent and improved visitor experiences and commercial services. Clarifications are made to ensure that the regulations reflect the current state of the resources. Multiple outdated and/or no longer needed regulations will be removed resulting in a substantial decrease in the number of Glacier Bay specific regulations as well as increased flexibility.

What has the park done?

With the gull egg harvest regulation as the main driver for the need for updated regulations, NPS has completed a draft regulation package for Glacier Bay National Park and Preserve that would simplify a number of regulations and eliminate obsolete regulations and language. The park has begun the creation of an adaptive management framework for a cooperative harvest plan with the Huna

Tlingit. As part of NPS' gull monitoring and research program, in 2015 Hoonah Indian Association (HIA) tribal members collected one hundred gull eggs from two colonies and assisted NPS biologists in conducting a full census of nests and contents and measuring harvested eggs. The harvested eggs were distributed among Huna elders and other tribal members and used to bake cupcakes for a school picnic to help reintroduce children to this culturally important food.

What next?

The regulation package is currently being edited to address all of the identified concerns. The regulation package represents progress towards the incoming administration's goal of decreased complexity and number of regulations. It is expected that the State of Alaska will be supportive of most if not all of these regulatory changes. The NPS has informed the State of Alaska about the effort. The next step will be to present the package to the AK regional office directorate for review and approval.

Issue/Challenge #6

Lost capability (plane and open ocean capable vessel) to access large parts of the park throughout the year

What is the issue?

Over the last decade the park has lost its open ocean capable vessel as well as its aircraft operation, while retaining only its within-bay fair weather boat capacity. This has meant that larger portions of the park are not patrolled or accessed and that in the most heavily used portion of the park, the NPS is only capable of operations of limited time length and during good weather conditions. The park has had large boat capacity since it had facilities and the lack of this capacity has significantly decreased its capabilities to conduct research and protect the outer coast. Unfortunately, this loss of vessel capability has also occurred during the same time that the park lost its aircraft capability. Recent changes in the availability of local aircraft have made this loss of park aircraft more acute.

What has the park done?

The park has worked with Wrangell St. Elias National Park and Preserve to have a shared ranger pilot position, changing the duties of the existing shared position. An aircraft is available and the park is trying to redirect resources to this need.

What next?

The park will instigate a vessel needs assessment to establish what future capabilities and platform it requires. It is hoped that a regional approach to large vessel replacement will be developed.

Issue/Challenge #7

Securing the successes in changing park and Tlingit tribal relationships

What is the issue?

Glacier Bay National Park and Preserve is the ancestral homeland of the Huna Tlingit. Although glacial advances overran villages inside the bay in the 1700s, the Huna Tlingit re-established numerous fish camps and several seasonal villages soon after glacial retreat. The Establishment of Glacier Bay National Monument (and later National Park) and implementation of laws and park regulations led to a period of alienation and strained relationships between tribal people and the National Park Service. The NPS approached the tribe in the mid-90s to understand how to best to move forward to heal and build a new relationship.

What has the park done?

The Huna Tribal House was completed in mid-summer 2016. The August 25, 2016 Grand Opening Celebration included the welcoming of traveling canoes, a traditional Tlingit house dedication ceremony, and traditional song and dance. The event attracted more than 800 participants including tribal members, other native representatives, and the visiting public and was live-streamed for those unable to attend.

The tribe and the National Park Service are completing an Interpretive Plan for the Tribal House, anticipating that the site will serve as a unique venue for tribal members to share their culture and history with the visiting public. The partners are developing wayside exhibits, short films, and other educational materials. Importantly, the National Park Service and the tribal government are exploring ways to build federal career pathways for tribal members interested in sharing their culture and expertise at the Tribal House.

The Tribal House will also be used for a range of cultural activities including language retreats, traditional memorial gatherings, spirit camps, and Tribal Council meetings. Such activities will facilitate the preservation of ethnographic resources important to the park,

encourage tribal participation in park management, and continue to strengthen relationships between the tribe and the National Park Service.

What next?

The park is at a cusp in relationship building. A "Healing Totem Pole" is currently being carved by tribal craftsmen. It will commemorate the evolving relationship between the tribe and the National Park Service and will become part of the fabric of our communication with each other and park visitors. The park will be implementing the Traditional Egg gathering legislation for GBNPP as well as exploring the new plant gathering regulations with the tribe.

Issue/Challenge #8

Management of charter and sport fisheries activities

What is the issue?

Previously, the park and the region made the determination that charter-vessel fishing operations were necessary and appropriate. With these services being necessary and appropriate, they should only be authorized under concessions contracts; however, this was not the case and some were authorized as Commercial Use Authorizations (CUAs). Having two different commercial authorizations is confusing. The number of charter vessel operations focusing on guided sport fishing has increased dramatically since 2006. Commercial fishing effort and harvest within Glacier Bay proper, in contrast, have declined over this same time. Continued commercial Lifetime Access Permit fishery attrition and eventual fishery cessation will remove this source of fishery mortality. While it is currently unknown how cessation of commercial fishery mortality will affect Glacier Bay halibut, increased recreational sector demand for access to this fishery is anticipated. While NPS management policies require that commercial and unguided recreational fisheries not exceed an unacceptable impact threshold, the threshold for charter fishing activities is a lower, minimal impact threshold. It is difficult to regulate number and quality of CUA operations as compared to concessions contracts.

What has the park done?

The park is preparing to begin work on the Charter Vessel Prospectus in 2017. With this contract coming up, it provides the opportunity to resolve this conflict and eliminate the unnecessary use of two separate authorities for the same service types.

What next?

The park wants to create commercial service zones within the Glacier Bay NPP boundary and convert all Charter Vessel commercial use authorizations to concessions contracts. This would insure that: 1) all Charter Operations are held to equal standards of resource protection and park experience; 2.) that the numbers of operators are not beyond capacity; and 3.) that there is sufficient economic opportunity so as to provide for competition and quality of operations.

Issue/Challenge #9

Wilderness planning, wilderness character monitoring, and commercial wilderness services

What is the issue?

The park does not have a Wilderness Plan that meets NEPA guidelines. Neither has the existing plan been integrated or used to guide the Frontcountry Plan or Vessel Management Plan leading to significant confusion and conflict in park management of wilderness areas. Commercial services were never evaluated "for the extent necessary" in Wilderness. Wilderness has not been monitored for maintenance of standards applicable to the Wilderness Act.

What has the park done?

The park has begun drafting an updated Frontcountry Management Plan that will be completed in 2018. This plan will help set the stage for a Wilderness Stewardship Plan, with particular usefulness in relationship to trail planning. Research has begun on visitor expectation and experience in Wilderness that should be focused on as indicators of wilderness quality.

What next?

The park is beginning the planning process for the Wilderness Stewardship Plan in 2018 and intends to finish the plan by 2020.

Issue/Challenge #10

Preserving the historical legacy of research and promoting the park as a living laboratory

What is the issue?

The importance of the role of research is recognized twice in the enabling legislation forming the core of park purpose, along with easy access to a pristine tidewater glacier environment. The park is recognized first as a living laboratory to understand ecological change within a deglaciated environment. The second recognition is need for the park to preserve the record of exploration. Glacier Bay has a high quality interpretation operation on every cruise ship and tour boat. The park's education program reaches into many classrooms through its "green screen" live video programs. No other park has as specific mandate in its organic legislation to implement a Research Learning Center (RLC) concept than Glacier Bay. That being to promote outside research, preserve the record of this research and communicate those results to scientist and the public.

What has the park done?

The park identified in its previous frontcountry plan even before the concept of RLC was developed, that a laboratory and logistical support center to support research tied to its enabling legislation was needed. It was recognized that this center would help preserve the record of research and would provide for better integration of this fundamental aspect of the park in interpretation and education programs. In the new frontcountry plan, this vision has been recognized and expanded due to the additional opportunity to enhance the frontcountry experience and lodge viability with the change in visitor needs and desires for longer more immersive experiences. In addition, technology has allowed the park to overcome much of the distance challenges that precluded education programs in the past.

What next?

The Frontcountry Management Plan will be finalized in 2018. The park will be seeking opportunities to partner with other organizations and the tourism industry to develop a facility that will support research, preserve the record of research and exploration and provide for expanded education opportunities. The park will be exploring a model such as the Murie Science and Learning Center, which leverages private funding, integrates park operations, and uses some fee-based programs to support the center.

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See the State of the Park Report for the Park website for a more complete list of references to documents and data sets upon which the assessments in this State of the Park report are based. References for several of the key documents cited in this report are as follows:

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See Also:

Collection of Natural Resource-Related References

Collection of Cultural Resource-Related References

Collection of Visitor Experience-Related References

Glossary

See the State of the Parks home page for a link to a complete glossary of terms used in State of the Park reports. Definitions of key terms used in this report are as follows:

Key Term	Definition
Americans with Disabilities Act (ADA)	Law enacted by the federal government that includes provisions to remove barriers that limit a disabled person's ability to engage in normal daily activity in the physical, public environment.
Archeological Sites Management Information System (ASMIS)	The National Park Service's standardized database for the basic registration and management of park prehistoric and historical archeological resources. ASMIS site records contain data on condition, threats and disturbances, site location, date of site discovery and documentation, description, proposed treatments, and management actions for known park archeological sites. It serves as a tool to support improved archeological resources preservation, protection, planning, and decision-making by parks, centers, regional offices, and the national program offices.
Baseline Documentation	Baseline documentation records the physical condition of a structure, object, or landscape at a specific point in time. A baseline provides a starting point against which future changes can be measured.
Cultural Landscapes Inventory (CLI)	A Cultural Landscapes Inventory describes historically significant landscapes within a park. The inventory identifies and documents each landscape's location, size, physical development, condition, characteristics, and features, as well as other information useful to park management.
Cultural Landscape Report (CLR)	A Cultural Landscape Report is the principal treatment document for cultural landscapes and the primary tool for long-term management of those landscapes. It guides management and treatment decisions about a landscape's physical attributes, biotic systems, and use when that use contributes to historical significance.
Curation	National parks are the stewards of numerous types of objects, field notes, publications, maps, artifacts, photographs, and more. The assemblage of these materials comprises a museum collection. Curation is the process of managing, preserving, and safeguarding a collection according to professional museum and archival practices.
Facility Condition Index (FCI)	FCI is the cost of repairing an asset (e.g., a building, road, bridge, or trail) divided by the cost of replacing it. The lower the FCI number, the better the condition of the resource.
Foundation Document	A park Foundation Document summarizes a park's purpose, significance, resources and values, primary interpretive themes, and special mandates. The document identifies a park's unique characteristics and what is most important about a park. The Foundation Document is fundamental to guiding park management and is an important component of a park's General Management Plan.
Fundamental and Other Important Resources and Values	Fundamental resources and values are the particular systems, processes, experiences, scenery, sounds, and other features that are key to achieving the park's purposes and maintaining its significance. Other important resources and values are those attributes that are determined to be particularly important to park management and planning, although they are not central to the park's purpose and significance. These priority resources are identified in the Park Foundation Document and/or General Management Plan. The short-cut name that will be used for this will be Priority Resources.
General Management Plan (GMP)	A General Management Plan is a strategic planning document that outlines the future management of a National Park Service site for the next 15 to 20 years. The plan will set the basic philosophy and broad guidance for management decisions that affect the park's resources and the visitor's experience.
Green Parks Plan (GPP)	The Green Parks Plan defines a collective vision and a long-term strategic plan for sustainable management of NPS operations. A critical component of the implementation of the GPP will be informing and engaging park staff, visitors, and community partners about climate change and sustainability to broaden opportunities to foster change.

Key Term	Definition
Historic Integrity	Historic Integrity is the assemblage of physical values of a site, building, structure, or object and is a key element in assessing historical value and significance. The assessment of integrity is required to determine the eligibility of a property for listing in the National Register.
Historic Resource Study (HRS)	The historic resource study is the primary document used to identify and manage the historic resources in a park. It is the basis for understanding their significance and interrelationships, a point of departure for development of interpretive plans, and the framework within which additional research should be initiated.
Historic Structures Report (HSR)	The historic structure report is the primary guide to treatment and use of a historic structure and may also be used in managing a prehistoric structure.
Indicator of Condition	A selected subset of components or elements of a Priority Resource that are particularly "information rich" and that represent or "indicate" the overall condition of the Priority Resource. There may be one or several Indicators of Condition for a particular Priority Resource.
Integrated Resource Management Applications (IRMA)	The NPS-wide repository for documents, publications, and data sets that are related to NPS natural and cultural resources.
Interpretation	Interpretation is the explanation of the major features and significance of a park to visitors. Interpretation can include field trips, presentations, exhibits, and publications, as well as informal conversations with park visitors. A key feature of successful interpretation is allowing a person to form his or her own personal connection with the meaning and significance inherent in a resource.
Invasive Species	Invasive species are non-indigenous (or non-native) plants or animals that can spread widely and cause harm to an area, habitat, or bioregion. Invasive species can dominate a region or habitat, out-compete native or beneficial species, and threaten biological diversity.
List of Classified Structures (LCS)	LCS is an inventory system that records and tracks the condition of the approximately 27,000 historic structures listed in the National Register of Historic Places that are the responsibility of NPS.
Museum Collection	NPS is the steward of the largest network of museums in the United States. NPS museum collections document American, tribal, and ethnic histories; park cultural and natural resources; park histories; and other aspects of human experience. Collections are managed by professionally-trained NPS staff, who ensure long-term maintenance of collections in specialized facilities.
National Register of Historic Places (NRHP)	The National Register of Historic Places is the official list of the Nation's historic properties worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources. Listing in the National Register of Historic Places provides formal recognition of a property's historical, architectural, or archeological significance based on national standards used by every state. The National Register is a public, searchable database about the places.
Native American Graves Protection and Repatriation Act (NAGPRA)	A federal law passed in 1990. NAGPRA provides a process for museums and federal agencies to return certain Native American cultural items (e.g., human remains, funerary objects, sacred objects, objects of cultural patrimony) to lineal descendants and culturally-affiliated Indian tribes and Native Hawaiian organizations.
Natural Resource Condition Assessment (NRCA)	A synthesis of existing scientific data and knowledge, from multiple sources, that helps answer the question: what are current conditions of important park natural resources? NRCAs provide a mix of new insights and useful scientific data about current park resource conditions and factors influencing those conditions. NRCAs have practical value to park managers and help them conduct formal planning and develop strategies on how to best protect or restore park resources.

Key Term	Definition
Priority Resource or Value	This term refers to the Fundamental and Other Important Resources and Values of a park. These can include natural, cultural, and historic resources as well as opportunities for learning, discovery, and enjoyment. Priority Resources or Values include features that have been identified in park Foundation Documents, as well as other park assets or values that have been developed or recognized over the course of park operations. Priority Resources or Values warrant primary consideration during park planning and management because they are critical to a park's purpose and significance.
Project Management Information System (PMIS)	A servicewide intranet application within the National Park Service to manage information about requests for project funding. It enables parks and NPS offices to submit project proposals to be reviewed, approved, and prioritized at park units, regional directorates, and the Washington Office.
Resource Management	The term "resources" in NPS encompasses the many natural, cultural, historical, or sociological features and assets associated with parks. Resource management includes the knowledge, understanding, and long-term stewardship and preservation of these resources.
Southeast Alaska Inventory and Monitoring Network (SEAN)	One of 32 I&M networks established as part of the NPS Inventory and Monitoring Program. Southeast Alaska Inventory and Monitoring Network provides scientific data and expertise for natural resources in 3 parks located in Glacier Bay National Park and Preserve, Klondike Goldrush National Historical Park and Sitka National Historical Park.
Specific Measure of Condition	One or more specific measurements used to quantify or qualitatively evaluate the condition of an Indicator at a particular place and time. There may be one or more Specific Measures of Condition for each Indicator of Condition.
Volunteers In Parks Program (VIP)	The Volunteers In Parks Program was authorized by Public Law 91–357 enacted 1970. The primary purpose of the VIP program is to provide a vehicle through which the National Park Service can accept and utilize voluntary help and services from the public. The major objective of the program is to utilize this voluntary help in such a way that is mutually beneficial to the National Park Service and the volunteer. Volunteers are accepted from the public without regard to race, creed, religion, age, sex, sexual orientation, national origin, or disability.
Wilderness	A designation applied to certain federal lands set aside for preservation and protection in their natural condition, in accordance with the Wilderness Act of 1964.