USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Chugach National Forest July 2024

Biennial Monitoring Evaluation Report for the Chugach National Forest

Fiscal years 2022-2023

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Why Monitoring Matters

There is no single correct approach to managing a forest or grassland. Each decision maker must weigh the ecological complexity of the ecosystems, the social and economic contributions, the changing environmental conditions, the many different viewpoints of the public, and uncertainty about long-term consequences.

Data from monitoring can therefore be extremely useful. A robust, transparent, and meaningful monitoring program can provide information on specific resources, management impacts, and overall trends in condition – in other words, feedback on whether we are meeting our management objectives.

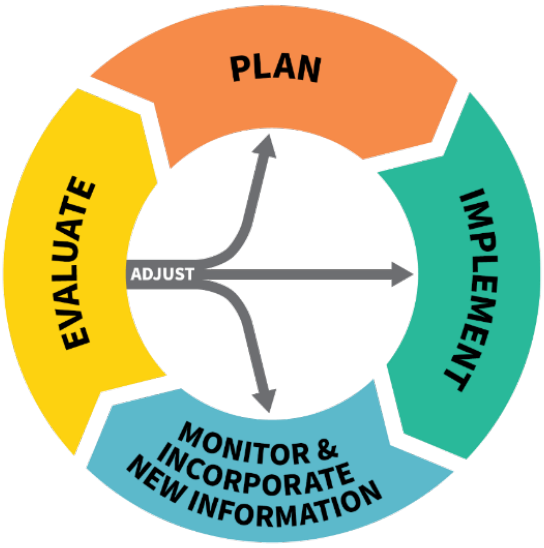
Every national forest or grassland has a land management plan that balances tradeoffs among recreation, timber, water, wilderness, wildlife habitat, and other uses. The plan describes a set of desired conditions – a science-based vision for the state of the forest or grassland once the goals of the plan are met. The land management plan includes a monitoring plan, organized around a set of monitoring questions and indicators that are designed to track progress toward achieving the desired conditions. Monitoring of certain resources is required by law, regulation, or policy (see box below for required monitoring topics). Other monitoring occurs depending on specific needs of the national forest or grassland. Under the current planning rule, monitoring questions developed for the monitoring plan must be "within the financial and technical capability" of the Forest Service, meaning that we must have the money and ability, including support from partners, to actually carry out the strategic monitoring outlined in the monitoring plan.

Every 2 years, each forest or grassland compiles and evaluates monitoring results and drafts a biennial monitoring evaluation report (BMER) like this one. If the monitoring report reveals that we are not quite meeting the mark, then there might be a need to change the land management plan, the management activities, the monitoring plan, or to reassess current conditions and trends—this is adaptive management. Monitoring results allow us to learn through management and adjust our strategies based on what we learned. Monitoring also helps us be accountable and transparent to interested and affected parties and colleagues. BMERs are critical to adaptive management because they tell us and the public whether the land management plan is working. Although we don't make any decisions in BMERs, they are a great opportunity to document and share monitoring results.

Our land management plan is available on our website; the monitoring plan chapter can be found by scrolling to Appendix A. Monitoring Program. The methodology used to address each monitoring question can be found on our monitoring website.

Monitoring questions must address the following topics (per 36 CFR sec 219.12 - Monitoring and Forest Service Manual 1909.12 sec. 32.13 - Content of the Plan Monitoring Program):

1. Status of select watershed conditions.
2. Status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
3. Status of focal species to assess the ecological conditions.
4. Status of a select set of the ecological conditions to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
5. Status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
6. Measurable changes on the plan area related to climate change and other stressors that might be affecting the plan area.
7. Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.
8. Effects of each management system to determine that they do not substantially and permanently impair the productivity of the land.
9. Social, economic, and cultural sustainability must also be addressed in the monitoring plan because sustainability is an inherent part of several of the required monitoring items.



Adaptive Management Cycle

Partnerships and Data Sources

To accomplish our mission, the Forest Service partners with land management agencies across all levels of government, with nonprofit and for-profit entities, universities, and communities large and small. The diversity of our partners parallels the breadth of Forest Service work that includes: managing the nation's 193 million acres of National Forest System lands to sustain healthy terrestrial and aquatic ecosystems; conducting collaborative research that connects the agency to hundreds of partners around the world; supporting States, Tribes, communities, and nonindustrial private landowners through technical and financial assistance; protecting communities and the global environment from catastrophic wildland fires, climate change and invasive species; and inspiring life-long connections to nature for every American.

We also rely on existing data sources such as national and regional inventory, monitoring, and research programs; Federal, State, or local government agencies; scientists, partners, and members of the public; and information from Tribal communities and Alaska Native Corporations.

Report Summary

This 2024 biennial monitoring evaluation report (BMER) for the Chugach National Forest documents monitoring activities that occurred during fiscal years 2022 through 2023. Resource specialists answered 9 of the 9 monitoring questions using 31 of the 31 indicators to determine if current activities described in the 2020 Chugach National Forest Monitoring Plan are moving the forest toward or maintaining the desired conditions or objectives.

The detailed resource data and specialist reports and monitoring guides that were used to build this monitoring report are available on request by contacting us at 161 E 1st Ave, Anchorage, Alaska, 99501, (907) 793-9500, Email: sm.fs.chugachplan@usda.gov. Each new monitoring report builds upon the evaluations and recommendations that precede it. This monitoring and evaluation report and previous reports are available at Chugach National Forest - Planning (usda.gov) where you can review previous recommendations made to move our forest toward the desired conditions and objectives in our land management plan.

If certain monitoring questions are not answered in this report either the available data were unclear, or we lack the capacity to compile or analyze it. In those cases, we explain the reason for not answering the question in this report; for example, we might say "we do not have sufficient data at this time," or "this question will be addressed in the next monitoring report because data for this resource are collected on a 5-year cycle."

Of the nine monitoring questions examined, we are meeting plan objectives or progressing toward our desired conditions in eight. To move the Chugach National Forest closer to the desired condition for ecosystem processes, we need to continue invasive species monitoring efforts for the remainder of the analysis period, at which point changes to management activities may be considered. Suggested improvements in other areas that are enumerated in the Summary of Results and Recommendations table (Table 29) will help ensure that the Chugach National Forest continues to meet its Land Management Plan objectives.

Table 1 – Recommended Changes

The following table tallies our recommended changes based on evaluation of the monitoring questions addressed in this report. It provides the overall totals for how many monitoring questions or indicators are meeting the forest plan direction, or whether changes to the forest plan, management activities, monitoring plan, or new assessment should be considered. See Table 29 at the end of this report for a more detailed summary of the monitoring questions, results, and recommendations.

Table 1. Adaptive management recommendations for all monitoring questions addressed in this report.

Recommendations	Yes	No	Uncertain
Land Management plan direction met	8	1	
Change to land management plan		9	
Change to management activities	1	8	
Change to monitoring plan	1	8	
Focused assessment needed	2	7	

Forest Supervisor's Certification

This report documents the results of monitoring activities that occurred from fiscal year 2022 through fiscal year 2023 on the Chugach National Forest.

I have evaluated the monitoring and evaluation results presented in this report. I have examined the recommended changes. I therefore consider the 2020 Land Management Plan sufficient to continue to guide land and resource management of the Chugach National Forest and plan a deeper examination of the recommended changes through engagement with resource specialists.

JEFF SCHRAMM

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JEFF SCHRAMM
FOREST SUPERVISOR

Status of Select Watershed Conditions

Watershed condition is the state of physical and biological characteristics and processes within a watershed that affect the hydrologic and soil functions supporting aquatic and terrestrial ecosystems. Functioning watersheds generally provide high quality water, recharge streams and aquifers, moderate climate variability, and support long-term soil productivity. Additionally, healthy watersheds create and sustain resilient terrestrial, riparian, aquatic and wetland habitats that support diverse populations of plants and animals capable of rapid recovery from natural and human disturbances. Properly functioning watersheds also provide many important ecosystem services and provide a substantial contribution to social and economic sustainability in southcentral Alaska.

The condition of watersheds affects just about every other natural resource. Because of this, the Forest Service has developed nationwide programs to monitor and manage water quality and watershed condition on National Forest System lands. These programs use the best available science, and include current, vetted technical field protocols, data management structures, and periodic evaluation and reporting requirements.

We evaluated our use of Best Management Practices (BMP) in our management activities; specifically, how well they were implemented and how effective they were in maintaining or improving watershed integrity. We also evaluated changes in Watershed Condition Classification (WCC) ratings resulting from management activities across the forest in select watersheds.

The following results reflect a summary and updates from data we collected over the four-year period of 2020-2024 for best management practices. WCC ratings are performed on a five-year cycle, with the next occurring in 2026, thus no new WCC results are included in this report.

Monitoring Question 1. Are management actions effective in maintaining or improving watershed integrity?

Indicator 1.1. National best management practices ratings

Key Results

BMP implementation and effectiveness were rated highly in 2022 and 2023 project and site reviews. BMPs were mostly to fully implemented on 70% of projects (Table 2) and BMPs were mostly to fully effective on 80% of projects (Table 3). Minerals, recreation, chemical uses, and roads projects rated well for both implementation and effectiveness. BMPs were marginally implemented on vegetation projects, and one of the two facilities and nonrecreational special uses projects rated poorly for both BMP implementation and effectiveness.

Table 2. 2022-2023 BMP Implementation Ratings by Resource Category

Rating	Number (%) of Evaluations	Resource Category
Fully Implemented	6 (60%)	Minerals, Recreation (2), Chemical Uses, Facilities and Nonrecreational Special Uses, Roads
Mostly Implemented	1 (10%)	Minerals
Marginally Implemented	3 (30%)	Facilities and Nonrecreational Special Uses, Mechanical Vegetation (2)

Rating	Number (%) of Evaluations	Resource Category
Not implemented	0	
No BMPs	0	

Table 3. 2022-2023 BMP Effectiveness Ratings by Resource Category

Rating	Number (%) of Evaluations	Resource Category
Fully Effective	7 (70%)	Minerals (2), Recreation, Chemical Uses, Facilities and Nonrecreational Special Uses, Roads, Mechanical Vegetation
Mostly Effective	2 (20%)	Recreation, Mechanical Vegetation
Marginally Effective	1 (10%)	Facilities and Nonrecreational Special Uses
Not Effective	0	

BMP evaluations indicate that BMPs are effective when implemented. In general, BMP implementation ratings were worse than BMP effectiveness ratings. For all but one evaluation, less than fully effective ratings corresponded to poorer BMP implementation ratings. Review of individual evaluations indicate that some BMPs were overlooked in developing special uses permits and vegetation management projects. In addition, FS staff sometimes did not enforce permit stipulations or contract clauses.

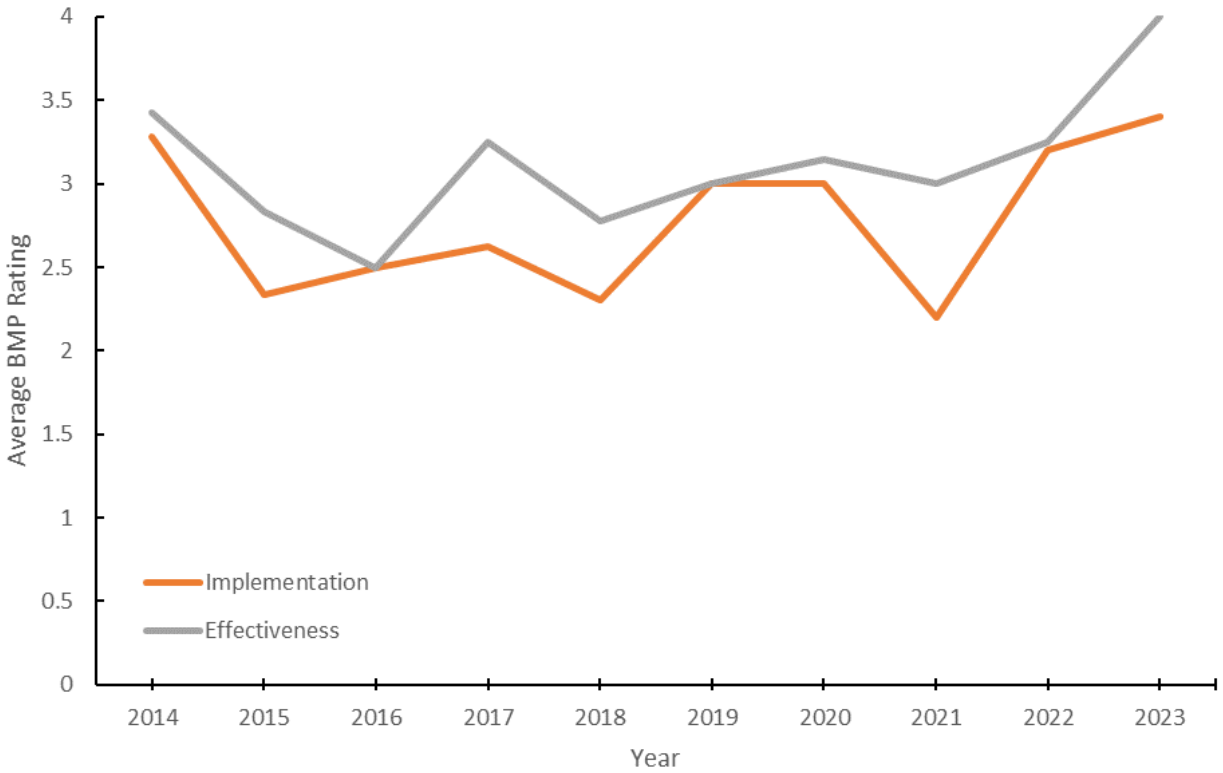

Figure 1. Average Best Management Practices implementation and effectiveness ratings through time, Implementation ratings are displayed in orange, effectiveness ratings in grey.

Recommendations

BMP evaluations suggest that management actions are maintaining or improving watershed integrity. Assessed projects, representing a range of management activities across the forest, rate highly on BMP implementation and effectiveness (Figure 1). As noted previously, BMP effectiveness could be improved through better project planning to identify applicable BMPs and regular inspection and enforcement of BMP application. In the last two years, the Chugach National Forest has hired additional watershed staff who can perform or assist with these tasks.

Indicator 1.2. Watershed Condition Classification Ratings

Key Results

The Chugach National Forest reassessed watershed condition according to the WCC in 2021. The next reassessment will be in fiscal year 2026, so there is no new information to include or analyze in this report. The Chugach has been engaged in some watershed-level condition assessments including a recent field test of a preliminary version of the revised WCC. An interdisciplinary team composed of Cordova Ranger District and forest-level staff rated the Alaganik Slough-Frontal Gulf of Alaska Watershed according to the new WCC 2.0, providing a valuable opportunity to learn about and provide guidance on the new classification scheme before applying it to watersheds across the forest.

Recommendations

No recommendations will be issued until the next analysis in 2026.

Table 4. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 1 MI 1.1	Management actions are maintaining or improving watershed integrity.	BMP effectiveness could be improved through better project planning to identify applicable BMPs and regular inspection and enforcement of BMP application
MQ 1 MI 1.2	The next reassessment will be in fiscal year 2026, so there is no new information to include or analyze in this report.	No recommendations will be issued until the next analysis in 2026.

Status of Select Ecological Conditions: Focal Species

Focal species, as defined by the U.S. Forest Service's 2012 Planning Rule, are a small subset of species whose status permits inference to the integrity of larger ecological systems. The Chugach National Forest has identified five invasive plants (four terrestrial and one aquatic) as our focal species, because their presence on the landscape has the potential to reduce local biodiversity and disrupt valued ecosystem functions. Therefore, the presence and abundance of these focal species in the plan area is believed to be an indicator of ecosystem dysfunction or degradation and negatively effects our ability to achieve the Forest's desired condition for ecosystems processes and conditions (FW-GL3-EPC-DC). Our objective is to monitor trends in the distribution and abundance of these focal species. Understanding these trends will help us to prioritize and evaluate the efficacy of our management activities and evaluate if the Forest's actions are contributing to a spread of focal species. The following results reflect data collected during fiscal years 2022 and 2023. Information from the last evaluation report (2011) has not been incorporated for terrestrial invasive species, those data will be used, if feasible, in the five-year analysis due in 2028.

Monitoring Question 2. Are management strategies effectively controlling or preventing the spread of invasive species in aquatic and terrestrial systems?

Indicator 2.1. Trend in the distribution and abundance of four highly invasive terrestrial plants (bird vetch, orange hawkweed, white sweetclover, and reed canarygrass)

Key Results

- 2022: 32 out of 109 monitoring polygons contained focal invasive species.
- 2023: 40 out of 177 monitoring polygons contained focal invasive species.

Recommendations

To move the Chugach National Forest closer to the desired condition for ecosystem processes, we need to continue monitoring efforts for the remainder of the analysis period, at which point changes to management activities may be considered. Although the Seward and Sterling Highways represent a primary vector for the spread of terrestrial invasive plants onto the Forest, and as such surveying these highways will be essential to understanding trends in the distribution of these focal species, surveying along these highways is also extremely dangerous and logistically challenging. After two years of monitoring, it is evident surveying the highway system monitoring polygons multiple times during the analysis period will not be safe or feasible. Therefore, we recommend returning to the stratified sampling strategy used during the previous Forest Plan monitoring effort. With a stratified sampling strategy, we decrease the probability of identifying small discrete infestations but feel this is a necessary tradeoff to ensure we safely collect enough data to analyze.

Indicator 2.2. Trend in geographic range and number of waterbodies infested with Elodea spp.

Key Results

Surveys conducted during the monitoring period identified one new infestation of *Elodea* in Crescent Lake on the Seward Ranger District (Table 5, Figure 3). This was the first occurrence of *Elodea* on the Seward Ranger District and the first new occurrence of *Elodea* on the Kenai Peninsula since infestations on the western portion of the peninsula were confirmed eradicated in 2022.

Table 5. Results of waterbodies Elodea survey conducted in 2022 and 2023. Prior to the current monitoring period, the following 8 waterbodies on the Cordova Ranger District were known to be infested with Elodea: Eyak Lake, McKinley Lake, Bering Lake, Martin Lake, Alaganik River/Slough, Eyak River, Wooded Pond, and Wrong-Way Pond.

Name	Ranger District	Years Surveyed	Elodea Present	New (since 2019)
Carmen Lake	Glacier	2022	No	No
Upper Russian Lake	Seward	2022	No	No
Coghill Lake	Glacier	2022	No	No
Swan Lake	Seward	2023	No	No
Juneau Lake	Seward	2023	No	No
Quartz Creek	Seward	2023	No	No
Lost Lake	Seward	2023	No	No
Explorer Ponds	Glacier	2022	No	No
Jerome Lake	Seward	2022	No	No
Lower Russian Lake	Seward	2023	No	No
Crescent Lake	Seward	2023	Yes	Yes
Lower Summit Lake	Seward	2022	No	No
Grayling Lake	Seward	2022	No	No
Wooded Pond	Cordova	2023	Yes	No
Wrong-Way Pond	Cordova	2023	Yes	No

Recommendations

We recommend continuing to survey lakes identified as a high risk for the introduction of *Elodea*.

Table 6. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 2 MI 2.1	New infestations of all four terrestrial species continue to occur across the forest.	Continue to survey established monitoring polygons to establish trends in terrestrial focal species. Implement new strategy for monitoring highways to increase field staff safety.
MQ 2 MQ 2.2	One new infestation of *Elodea* in Crescent Lake was identified on the Seward Ranger District.	Continue to survey lakes identified as a high risk for the introduction of *Elodea*.

Figure 2. Vets Work intern Alison Kapper removes the flowing heads of orange hawkweed to prevent seed dispersal while biological science technician Caitlin Luby collects data on the infestation.

Figure 3. Biological science technician Caitlin Luby holds a rake full of Elodea, which was documented for the first time in Crescent Lake in 2023.

Figure 4. A single white sweet clover plant introduced during recent road construction on the Seward Highway near Summit Lake was documented and removed during monitoring efforts.

Figure 5. Biological science technician Caitlin Luby pulls in a rake throw during Elodea surveys in Lost Lake.

Status of Select Ecological Conditions: Riparian, Wetland, and Aquatic Ecosystems

Watershed connectivity is the unimpeded hydrologic flow and up and downstream movement of aquatic organisms, nutrients, and energy throughout a watershed's interconnected web of aquatic pathways. For anadromous aquatic organisms, like Pacific salmon, watershed connectivity is critical to allow for unobstructed movement along the migration corridor to access key spawning and rearing grounds for sustained population productivity.

There are 97.28 miles of Forest Service system roads on the Chugach National Forest with approximately 290 stream crossings (including bridges) to evaluate and ensure aquatic organism passage. Additionally, there are roughly 140 individual forest-managed roads within, or adjacent to, forest lands under other jurisdictions.

The Chugach AOP program is guided by the "Chugach National Forest Aquatic Organism Passage Program Management Plan" (completed February 2024). The AOP PMP consists of a forest-wide process to improve watershed connectivity by identifying and eliminating barriers to aquatic organism passage. Through a cooperative effort between the Engineering and Resources staff, this program meets the Forest LMP infrastructure, fisheries, and watershed goals as well as forest and regional priorities.

Using the AOP PMP, our goal is to prioritize repair, restoration, or replacement of road-stream crossing structures that do not meet aquatic organism passage requirements or the requirements for current or projected stream flow. while outlining monitoring goals to ensure functionality of AOP projects.

Monitoring Question 3. Are management activities maintaining or improving aquatic habitat connectivity?

Indicator 3.1. Percentage of human-associated aquatic organism passage barriers improved or restored

Key Results

Our evaluations, inventory and GIS queries have identified the following key metrics within the Chugach National Forest boundary, (not jurisdiction specific):

- 169 Alaska Department of Fish and Game identified fish passages (both functional and non-functional stream crossings)
- Approximately 240 miles of road (both forest system and non-forest system roads)
- 752 Alaska Department of Transportation culverts (flood relief and stream crossings)
- 2022: one culvert was replaced by DOT in the Cordova Ranger District.
- 2023: two culverts were replaced, and the Forest Service completed a pre-construction longitudinal profile in the Cordova Ranger District as part of our forest-wide monitoring program.
- 2024 Summer Field Season anticipated the replacement of two culverts and one removal in the Cordova Ranger District.

In 2023 292 crossings (including bridges) were identified within the Chugach National Forest boundary. Initially we identified 23 high priority crossings for construction (Table 7) and began preliminary analysis in the summer of 2023. Eleven AOP culverts were assessed using protocols established by forest resources staff. In the summer 2024-25 field seasons we anticipate completion of the analysis for the

remaining crossings across the Forest. Once sites are evaluated, we will utilize prioritization criteria to rank the sites for survey, design, and implementation (construction).

Table 7. Listed below are the priorities for fish crossing work for the Chugach National Forest. For those culverts below priority number 14, the urgency to correct these problems is low due to very limited habitat. Forest Priorities for reconstruction based on benefit to fish populations (Ch=Chinook, Co=Coho, Pk=pPink, So=Sockeye, Ct=Cutthroat trout, DV=Dolly Varden, RBT=Rainbow trout, Lk=Lake trout).

District	Priority	FY	Project Title	Fish Present*	Available Habitat	Work Completed (NOTES)
		2023	Portage Pass Road Decommission			
		2024	AOP Design Contracts			Palmer Creek bridges and one AOP are currently in design
		2024	PALMER CREEK AQUATIC ORGANISM PASSAGE IMPROVEMENTS			
CRD	1	2024	Sheridan Glacier Rd 8000-210_3.051	Co, DV	1.6 km	New Bridge installed 2006
CRD	2	2024	Saddlebag Glacier Rd 8000-800-330.001-	Co, DV, Ct	1 km	Culvert Replaced 2004
CRD	3	2024	Sheridan Glacier Rd 8000-210.020 & 0.021	Co, DV	1.6 km	Unsure of ownership
GRD	4	2024	Center TS Road 4000425_0.500	Co, Ch, DV	7 acres. 0.5 km	Culvert pulled, but not replaced
SRD	5	2024	Tern Lake Rd 1000-900_0.31	Ch, Co, DV, So, Rbt	150 acres	Planning initiated in 2005
CRD	6	2024	Cabin Lake Rd 8000-200.718	Co, DV	1 km	
CRD	7	2024	Goat Camp Rd 8000-220.008	Co, Ct	10-75 acres	
CRD	8	2024	Goat Camp Rd 8000-220.306	Co, Ct	10-75 acres	
CRD	9	2024	Goat Camp Rd 8000-220.179	Co, Ct	10-75 acres	
CRD	10	2024	Alaganik Slough Rd 8000-240_1.197	Co	15-75 acres	
CRD	11	2024	Alaganik Sough Rd 8000-240_1.274	Co	15-75 acres	
CRD	12	2024	Power Creek Rd 8010_1.59	DV, Co, Rbt	0.5 km	
SRD	13	2024	Tenderfoot Campground Rd 4000-120_0.307	Lt, Rbt	300 acres, 0.4km	
SRD	14*	2024	Palmer Creek Rd 4460_6.903 & 6.904	DV	1.1 km	

District	Priority	FY	Project Title	Fish Present*	Available Habitat	Work Completed (NOTES)
SRD	15*	2024	Juneau Creek Rd 1010_1.393&2.323	DV	60 meters	
SRD	16*	2024	Eastside Rd 4000-080_0.311&0.876	DV	limited	
SRD	17*	2024	Trail River Campground Rd 2050-100_0.507	Ch, So, Co, Pk, DV	Almost none	
SRD	18*	2024	Resurrection Creek Rd 4460-100_2.958	DV	60 meters	
SRD	19*	2024	Palmer Creek Road 4460_8.205	DV	60 meters	
SRD	20*	2024	Palmer Creek Road 4460_8.700	DV	minimal	
SRD	21*	2024	Palmer Creek Road 4460_9.343	DV	minimal	
SRD	22*	2024	Palmer Creek Road 4460_10.468	DV	60 meters	
SRD	23*	2024	Palmer Creek Road 4460_10.479	DV	60 meters	
SRD			Palmer Creek and Trail River Bridges/AOP improvement			(Re-Submission - Redirected prior year GAOA funds to RRCG Phase 2 project, looking to make whole again.)

Recommendations

We have no recommended changes at this time, as we are still in the process of identifying and prioritizing repair and replacement of inadequate stream crossings and completing those already prioritized, designed, and funded on the forest. We will include new recommendations for repairs and replacements in the next biennial monitoring and evaluation report. Finally, we are considering adaptive management work on culverts that were recently installed, including navigating issues like beaver activity, further enhancement of vegetation on banks, and some sedimentation removal.

Table 8. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 3 MI 3.1	Crossings were identified. High priority crossings were identified for construction.	No recommended changes

Figure 6. Photos of culvert replaced with low water crossing construction in Cordova, May 2023.

Status of Select Set of Ecological Conditions Required to Contribute to Species Recovery

Dusky Canada goose and Aleutian cress have been identified as species of conservation concern for the Chugach National Forest. The 2020 forest plan guides us to conserve and maintain viable populations of these species. We are measuring six indicators, identified below, to determine trends in population and habitat condition for these species on the forest. Our goal is to determine if the forest plan desired conditions for terrestrial ecosystems and at-risk species are being met (FW-GL3-TE-DC). These monitoring results will help us to prioritize areas in need of management attention regarding species of conservation concern.

Monitoring Question 4. Are habitat conditions necessary to support populations of dusky Canada geese and Aleutian cress being maintained?

Indicator 4.1. Dusky Canada Goose: Population trends in the Copper River Delta

Key Results

- Results from the spring aerial survey in 2022 yielded a Total Breeding Ground Index, which includes those geese counted on Middleton Island, of 13,098 (SE=1,221; Figure 7); this was 7% below the 10-year average of 14,063 (SE=1,491) and resulted in a 3-year mean of 14,614 (SE=1,750).
- Results from the survey in 2023 yielded a Total Breeding Ground Index of 9,576 (SE=935; Figure 7); this was 31% below the previous year's estimate and 37% below the 10-year average of 13,884 (SE=1,477), resulting in a 3-year mean of 11,824 (SE=1,124).
- Over the past 35 years, the Total Breeding Ground Index has shown multiple oscillations from highs >16,000 to lows of <10,000 (Figure 7). As such, the current downward trend likely represents natural fluctuations, but highlights the need for continued monitoring.
- Below-average estimates of indicated population abundance suggest that the dusky Canada goose population is likely in a downward trend. The 3-year average of the Total Breeding Ground Index has decreased to 11,824 and remains below the 10-year average of 13,884; however, this estimate is 16% above the 10,000-bird population index required by the Pacific Flyway Council to maintain management Action Level 1 (no change in harvest), and 45% above the 7,500 population index threshold required to maintain "standard" hunting season regulations.

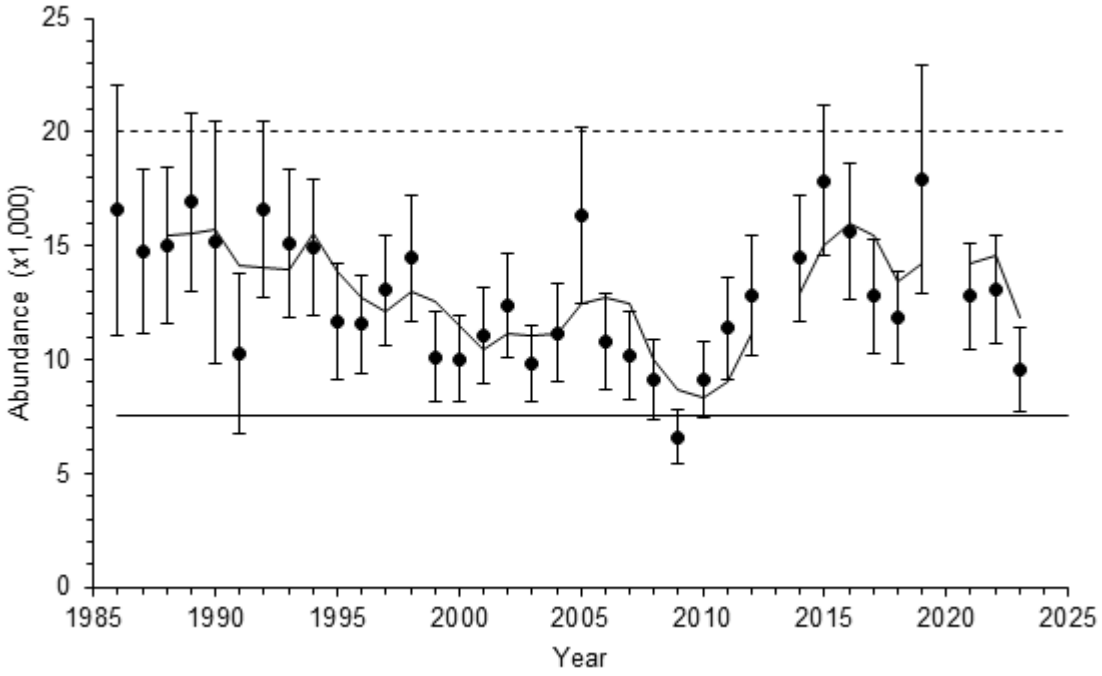

Figure 7. Total breeding ground index for dusky Canada geese, Copper River Delta and Middleton Island, Alaska, 1986–2023, with SE bars. The 3-year running average used for the management index is indicated by the solid line.

Indicator 4.2. Dusky Canada Goose: Nesting Success

Indicator 4.3. Dusky Canada Goose: Nest Predation

Key Results

- A total of 376 nest islands were monitored in 2022. Of these nest islands, 367 were available for use by dusky Canada geese (98%). A total of 139 dusky Canada goose nests were found on nest islands in 2022, representing a 38% occupancy rate. The fate of 6 nests were unknown (4%). Of the 133 nests with determined fates, 77 were successful (58%), 50 failed (38%), and 6 abandoned (5%). Based on membrane evidence following hatch, the average number of goslings produced per successful nest island was 4.4; the minimum estimate of the total number of goslings produced by the nest island program for the 2022 season was 337.
- A total of 379 nest islands were monitored in 2023. Of these nest islands, 374 were available for use by dusky Canada geese (99%). A total of 143 dusky Canada goose nests were found on nest islands in 2023, representing a 38% occupancy rate. The fate of 4 nests were unknown (3%). Of the 139 nest islands with determined fates, 83 were successful (60%), 51 failed (37%), and 5 abandoned (4%). Based on membrane evidence following hatch, the average number of goslings produced per successful nest island was 4.2; the minimum estimate of the total number of goslings produced by the nest island program for the 2023 season was 347.
- The number of successful nests in 2021 (n=47) was the lowest observed over the last 20 years of the nest island program, but rates of nest island occupancy and nesting success showed substantial

increases during both 2022 and 2023. The number of successful nests in 2023 (n=83) was the highest observed since 2016 and was above the 10-year average of 79.

- Following below average nest island occupancy and nest success in 2021, observed increases in productivity metrics during 2022 and 2023 may positively influence trends in total abundance.

Recommendations

Given recent results indicating potential downward projection in dusky Canada goose abundance, we recommend that additional effort be focused on investigating ways in which the nest island program can become more productive. This includes 1) identifying nest islands that have shown low or no production over the last 10 years, 2) determining which habitat variables are associated with the most successful nest islands, and 3) predicting new locations on the Delta for which to move unproductive nest islands. In addition, we recommend experimental deployment of elevated nesting platforms to assess their viability as an alternative to floating nest islands in areas where beaver damage consistently renders islands unusable to geese and increases annual maintenance needs.

Indicator 4.4. Trend of known populations of Aleutian cress

Key Results

- The known distribution of Aleutian Cress on the Chugach National Forest (Figure 10) has expanded because of new populations being discovered during the monitoring period.
- A total of 36 Aleutian cress element occurrences were documented in the Palmer Creek Watershed across an approximately 107-acre area (Figure 10).
    - Within these element occurrences, 10 permanent macroplots, containing a grid of between 12 to 25 1x1 meter quadrats were established and monumented.
        - A total of 219 quadrats were sampled in 2022 of which 71% had Aleutian cress present.
        - A total of 234 quadrats were sampled in 2023 of which 70% had Aleutian cress present.
- Two targeted surveys were conducted in July of 2023 in areas identified as suitable habitat for Aleutian cress. Both surveys successfully identified new populations:
    - The first population was found west of the headwaters of Summit Creek on the central Kenai Peninsula (Figure 8). This population consists of an estimated 100-300 individuals growing in mossy seeps and rivulets above an unnamed alpine lake which feeds Summit Creek. Further monitoring in the surrounding area is needed to determine the size of this population.
    - The second population was found north of Crystal Lake along Raven Creek in Crow Pass north of Girdwood (Figure 8). This population is larger and consists of an estimated 500-1000 individuals growing in saturated moss-covered rocky soils adjacent to the Crystal Lake and Raven Creek. The population is dispersed over approximately 30 acres. The Crow Pass population occurs near a popular Forest Service cabin, dispersed camping area and trail. Further assessments are needed to determine if there are any potential impacts to this population from recreational use.
- Additionally, a third new population was documented by botanists from the University of Alaska Anchorage while researching post glacial plant succession at the Wolverine Glacier, within the Nellie Juan–College Fjord Wilderness Study Area. Specimens were collected from this population and

deposited in the University of Alaska Anchorage Herbarium (UAAH). Forest staff are working with the botanists to obtain additional details about this discovery.

Recommendations

- Increase the focus of targeted survey efforts to better understand the distribution of Aleutian cress on the Chugach National Forest.
- Establish monitoring plots in Crow Pass and Summit Creek to monitor Aleutian Cress population trends on a broader scale.
- Investigate the feasibility of using historic aerial images to establish trends in tree and shrub cover within the Palmer Creek Valley (Figure 11).

Indicator 4.5. Tree and shrub encroachment in alpine habitat

Key Results

- Discussion of regional trends in tree and shrub land cover change can be found in Chapter 6, Indicator 6.2.
- Of the 49 known Aleutian cress element occurrences on the forest, 57% of Aleutian cress occurrences were associated with the dwarf shrub dominance type, 32% were associated with the low willow-dwarf birch dominance type, and 10% were associated with the mesic herbaceous dominance type.
- Of the 10 macroplots established in the Palmer Creek Valley, 4 have shrubs present within the macroplot, with an average shrub density of 0.86 stems per square meter.

Recommendations

See Chapter 6, Indicator 6.2.

Indicator 4.6. Persistence of Alpine Snowpack

Key Results

Discussion of regional trends in snowpack can be found in Chapter 6, Indicator 6.4.

Recommendations

See recommendations in Chapter 6, Indicator 6.4.

Table 9. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 4 MI 4.1 MI 4.2 MI 4.3	Following below average nest island occupancy and nest success in 2021, observed increases in productivity metrics during 2022 and 2023 may positively influence trends in total abundance soon.	We recommend that additional effort is focused on investigating ways in which the nest island program can become more productive.
MQ 4 MI 4.4	The known distribution of Aleutian Cress on the Chugach National Forest has expanded	• Increase the focus of targeted survey efforts to better understand the

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
	because of new populations being discovered during the monitoring period.	distribution of Aleutian cress on the Chugach National Forest. • Establish monitoring plots in Crow Pass and Summit Creek to monitor Aleutian Cress population trends on a broader scale.
MQ 4 MQ 4.5	Discussion of regional trends in tree and shrub land cover change can be found in Chapter 6, Indicator 6.2.	See Chapter 6, Indicator 6.2
MQ 4 MQ 4.6	Discussion of regional trends in snowpack can be found in Chapter 6, Indicator 6.4.	See Chapter 6, Indicator 6.4

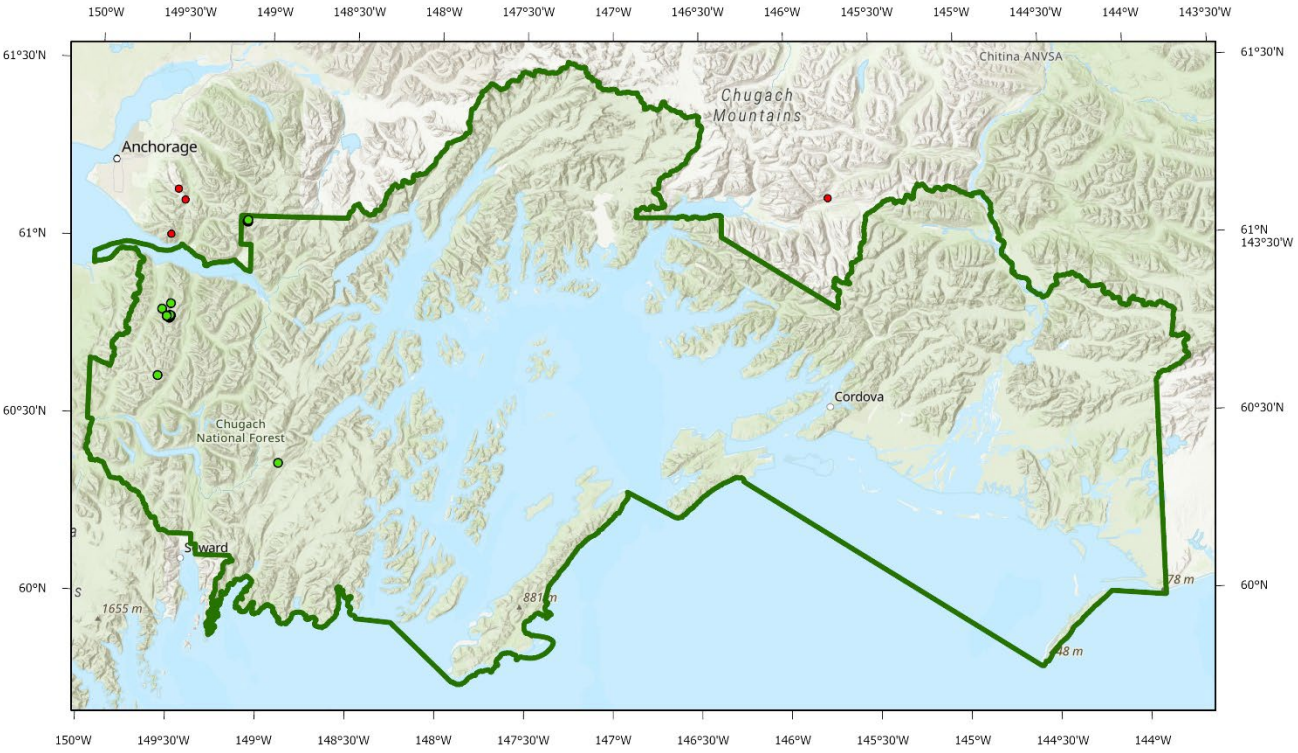

Figure 8. Map displaying known distribution of Aleutian cress (Aphragmus eschscholtzianus) in Chugach National Forest. Green dots represent occurrences on Forest Service lands and red dots represent occurrences not on Forest Service lands.

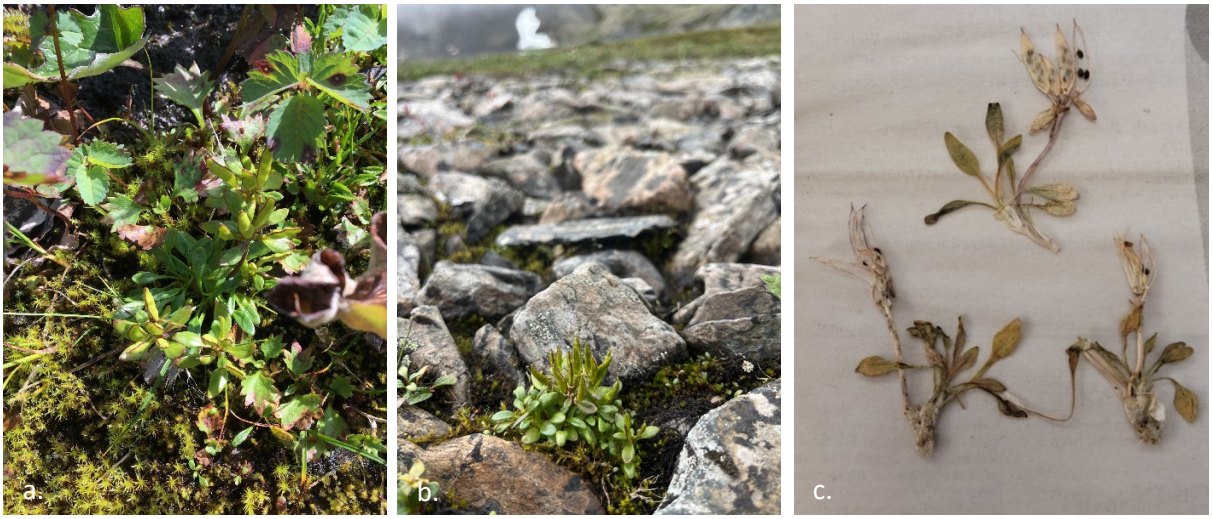

Figure 9. Three new populations of Aleutian Cress were identified in Chugach National Forest in 2023. Individuals are shown here from the populations in a) Summit Creek, b) Crow Pass, and c) Wolverine Glacier.

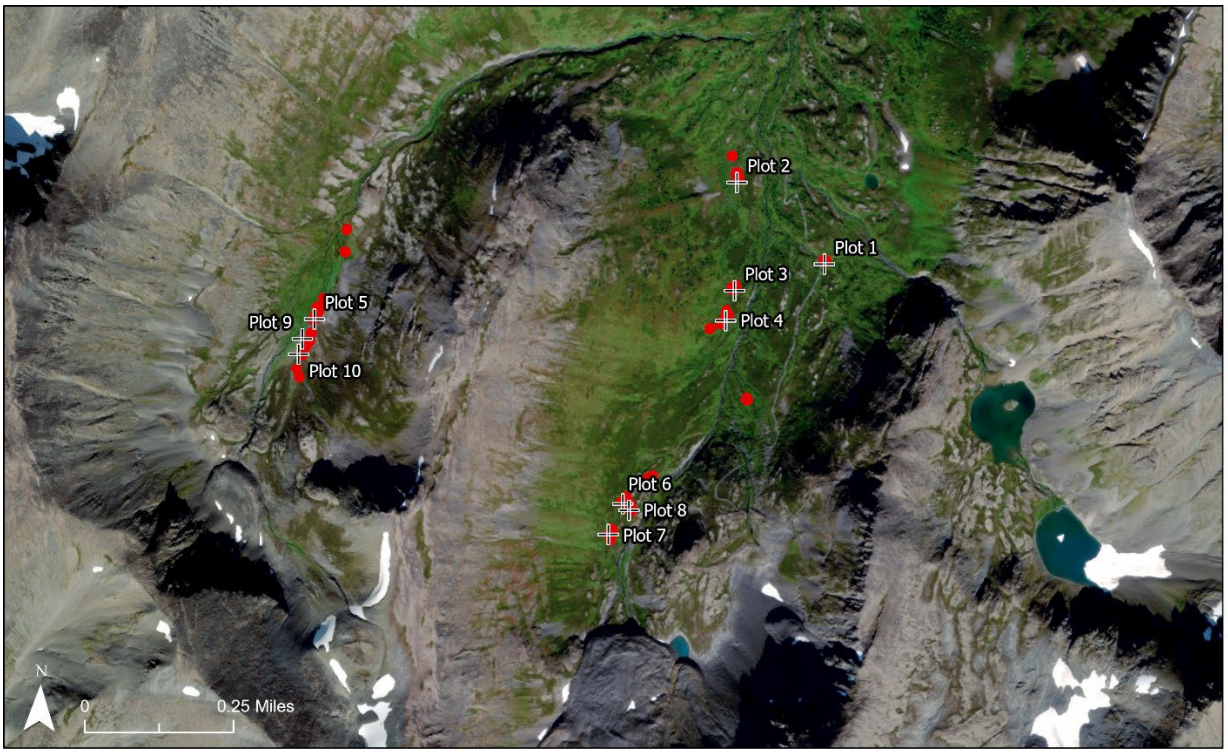

Figure 10. Distribution of Aleutian cress in the Palmer Creek watershed. Documented element occurrences are represented as red polygons. Monitoring plot locations are represented as black crosses.

Figure 11. Historic series of aerial photographs and satellite imagery of the Palmer Creek Valley.

Visitor Use, Satisfaction, and Progress on Recreation Objectives

The focus of monitoring visitor uses and recreation activities on the Chugach National Forest centers on sustainability of recreation facilities and providing desired recreation opportunities. One of the ways to provide sustainable ranges of recreation opportunities is to develop relationships and work effectively with partners and volunteers who help the Forest Service. Chugach National Forest staff are measuring levels of recreation use, sustainability of recreation facilities, and how engaged the communities, partners, volunteers, and businesses are in providing shared stewardship of recreation opportunities and infrastructure. This information will be used to determine if effort is needed to develop different recreation opportunities and facilities, more or different partnerships, engage more volunteers, and evaluate the adequacy and overall sustainability of recreation facilities. The following results reflect updates from data collected from our Natural Resource Management data portal and occupancy reporting from 2019 to December 2023, with emphasis on years 2022-2023 under the 2020 LMP direction.

Monitoring Question 5. Are recreation opportunities and infrastructure achieving desired conditions, and are they sustainable?

Indicator 5.1. Recreation facility occupancy rate

Key Results

The Forest's 41 public use cabins had an average occupancy rate of 35 percent in 2022 and, 32 percent in 2023 (Figure 12). The cabins had a five-year average occupancy of 32% (2019-2023), with occupancy steady over that period. Cabins that are more accessible have much higher occupancy rates than those in more remote and hard to reach locations; the occupancy rates for our ten most popular cabins show a five-year average occupancy rate of 63 percent. In general, these cabins are accessible from popular trailheads and often require shorter hikes to reach.

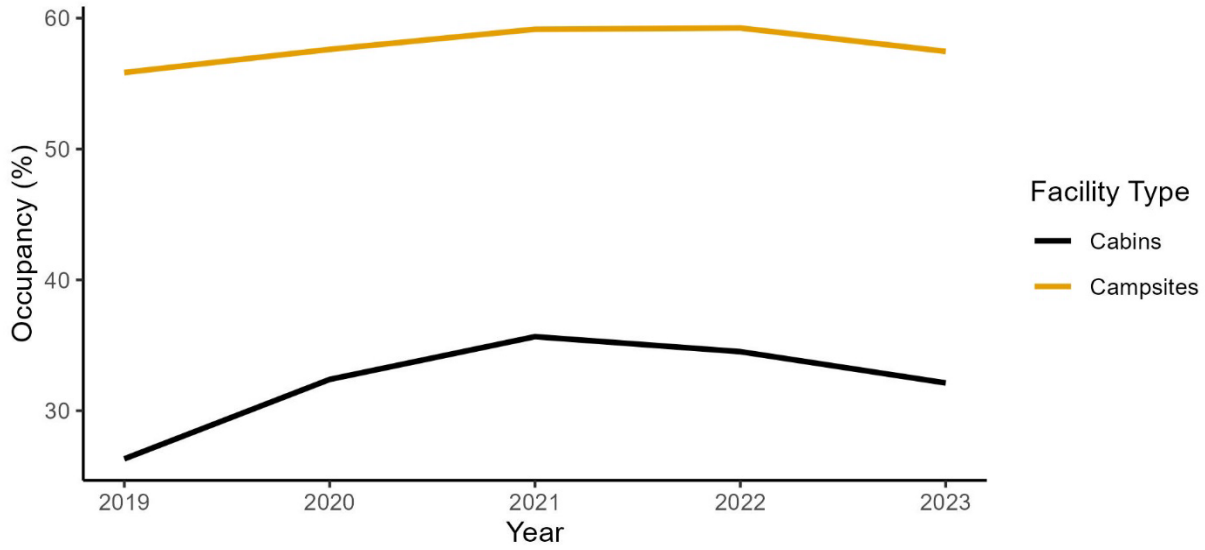

Figure 12. Five-year occupancy rates of public use cabins and campsites. Cabins and campsites are displayed in black and orange, respectively.

The 13 fee campgrounds in the Chugach National Forest had an occupancy rate of 59% in 2022 and 58% in 2023 (Figure 12). The campgrounds had a five-year average occupancy rate of 58% (2019-2023), with occupancy largely steady over this period. Campground occupancy varies from month to month with the peak use at the height of summer, roughly June-August. During the peak season our campgrounds are generally at capacity. No data was available from Couer D'Alene or Child's Glacier campgrounds, as they do not use the reservation system. The steady occupancy trend data suggests that the Chugach National Forest is providing desired camping recreation opportunities with its 13 concessionaire managed campgrounds.

Recommendations

The steady occupancy trend data suggests that the Chugach National Forest is providing desired camping recreation opportunities for both cabins and concessionaire managed campgrounds. We do not need to change forest plan language or management activities.

Further Comments

In 2021 the Bipartisan Infrastructure Bill was passed by Congress. With this Bill, the Alaska Region of the Forest Service saw significant investment in the Public Use Cabin Program. Over the next several years up to twelve new or remodeled cabins will be constructed through our partnership with the National Forest Foundation. One of the goals of the new cabins is to make them more accessible to the public. Several will be constructed adjacent to existing campgrounds, and some will require shorter hikes on popular trails. The first will be the Trail River Cabin which will be reservable in Spring of 2024. Additional cabins to be constructed include one adjacent to both Porcupine and Granite Creek Campgrounds, several along the Iditarod National Historic Trail and the reconstruction of the McKinley Lake cabin in Cordova. In addition to brand new cabins, the Chugach National Forest competed and received funding to address deferred maintenance on cabins through the Great American Outdoors Act (GAOA). These multi-year funds will help to address the maintenance backlog and give these much-loved cabins some attention. Cordova Ranger District will be reconstructing the Martin Lake and Port Chalmer's cabins as well with the GAOA funds. While continued investment in new cabins and the maintenance of existing cabins will only increase occupancy, there were several factors over the last five years which negatively affected occupancy rates, including cabin closures due to wildland fire, road construction, storm damage and cabins reaching the end of their lifespans.

Indicator 5.2. Number of outfitter guide permits issued and administered

Key Results

Authorizations administered:

2023 – 105 Outfitter Guide Permits were administered

2022 – 91 Outfitter Guide Permits were administered

We saw a slight increase in the number of outfitter and guides operating between 2022 and 2023. In addition, the last few permit Holders who had gone into "Non-Use" during the 2020 pandemic moved back into "issued" status and were operating. In 2023, Permit Administrators noticed a slight upswing in prospective permit holders interested in future Outfitter Guide Open Season opportunities.

Table 10. Outfitter and guide permitted activities reported for 2022 by geographic area. Tables 10 and 11 do not reflect all authorized activities for 2022 and 2023. Activity names match the R10 Flat Fee Schedule for 2023 R10 Supplement 2709.11-2020-1 FSH 2709.11 Section 37.21c – Exhibit 01.

Activity	Kenai Peninsula	Prince William Sound	East Copper River
Rafting	X		
Camping	X	X	X
Dog sledding	X		
Fishing	X		X
Hunting (includes camping)	X	X	X
Begich Boggs Visitor Center & Day Use Sites (interpretive use)	X		
Outfitting	X		
Heli-skiing Tours	X		X
Snowmobiling	X		
Remote Tours: Helicopter Landing Tours	X		
Remote Tours: Remote-Setting Nature Tours Hiking	X	X	X
Remote Tours: Remote-Setting Nature Tours Ski touring	X		X
Road-based Tours: Jet Boating	X		
Road-based Tours: Horse Trail Rides	X		
Road-based Tours: ATV Rides	X		

Table 11. Outfitter and guide permitted activities reported for 2023 by geographic area

Activity	**Kenai Peninsula**	**Prince William Sound**	**East Copper River**
Rafting	X		
Camping	X	X	X
Dog sledding	X		
Fishing	X		
Hunting (includes camping)	X	X	X
Begich Boggs Visitor Center & Day Use Sites (interpretive use)	X		
Outfitting	X		
Heli-skiing Tours	X		X

Activity	Kenai Peninsula	Prince William Sound	East Copper River
Snowmobiling	X		
Remote Tours: Helicopter Landing Tours	X		
Remote Tours: Remote-Setting Nature Tours Hiking	X	X	X
Remote Tours: Remote-Setting Nature Tours Ski touring	X	X	X
Road-based Tours: Jet Boating	X		
Road-based Tours: Horse Trail Rides	X		
Road-based Tours: ATV Rides			
Road-based Tours: Hiking	X	X	X

Recommendations

East Prince William Sound and East Copper River (Cordova Ranger District) have fewer active outfitter and guide operators compared to the rest of the Chugach National Forest. We have determined that it is beneficial to accept outfitter and guide proposals on a walk-in basis for specific activities and locations within eastern Prince William Sound and Copper River.

A Forest-wide open season for accepting outfitter and guide proposals for specific activities and locations began in 2018 and occurred again in 2020 and 2022. We anticipate offering an Outfitter & Guide open season in fall of 2024. Our intent is to continue offering biannual open seasons, dependent upon administrative capacity, to ensure all current authorizations are administered to standard.

In response to an increase in interest, the Forest is actively working on developing an outfitter guide prospectus for the Spencer Whistle stop and Grandview Whistle stop areas. The Forest is seeking to add opportunities for new uses in the area.

In Prince William Sound, the Forest has experienced a renewed interest in small cruise operators looking to conduct land-based activities on National Forest lands. The Forest has made determining the appropriate areas and use capacities for these new activities a priority planning project in 2024.

Indicator 5.3. Number of miles of trail maintained by volunteers and partners

Key Results

Looking at the past 10-year data set for NFST miles maintained by volunteers/partners there is a wide range of results (Figure 13). The average miles of trails maintained over a ten-year period was 8.47 miles (2013-2023). Trail miles maintained by partners has steadily increased post-pandemic. This could be in part due to an increased interest in outdoor recreation as well as engagement by Forest Service staff to ensure strong relationships with our volunteers and partners. Engaging with volunteers and partners and utilizing these relationships to increase stewardship has been a renewed focus both nationwide and within the Alaska Region. Result-driven initiatives like the 10-year Trail Shared Stewardship Challenge—billed as a call to action to increase our collective capacity to care for trails and increase on-the-ground results—will help to create a more sustainable trail system.

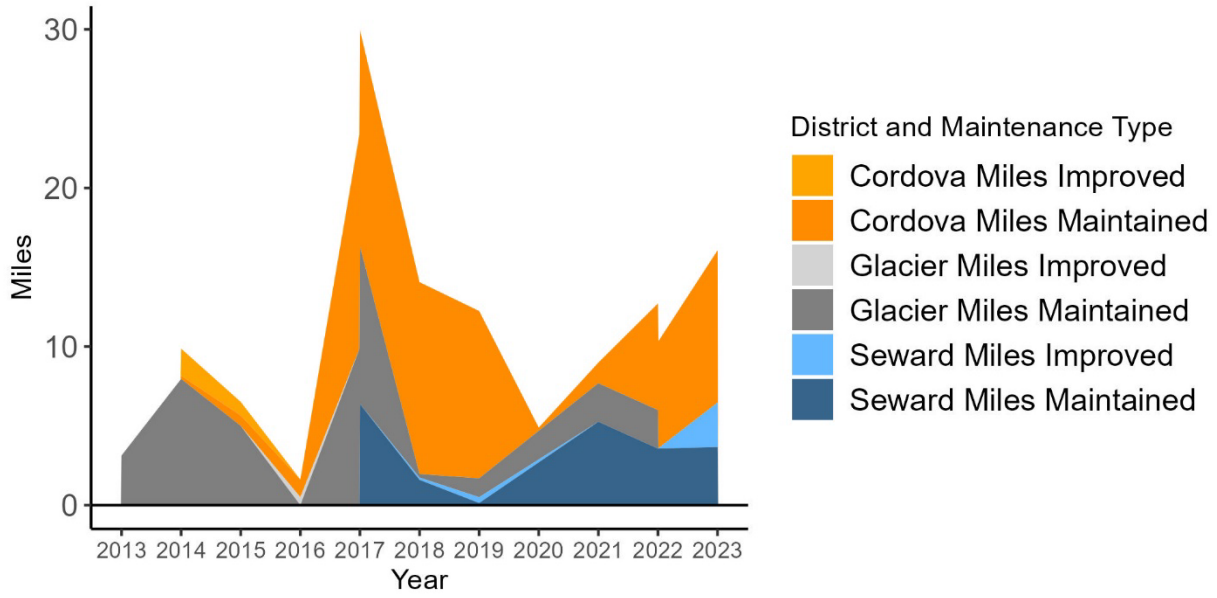

Figure 13. Ten-year comparison of miles of trail maintained by volunteers. Ranger districts are distinguished by color. Cordova is orange, Glacier grey, Seward dark blue. Miles improved are a lighter shade, and miles maintained darker.

Recommendations

Our continued effort to engage partners and volunteers to help with trail maintenance activities highlights our continued commitment to meeting our desired condition for this indicator. No changes to the forest plan or management actions are recommended.

Indicator 5.4. Number of recreation sites operated and maintained by volunteers and partners

Key Results

The total number of recreation sites operated and maintained by volunteers and partners has remained steady at 13 since 2020.

Recommendations

We do not need to change forest plan language or management activities.

Indicator 5.5 Total deferred maintenance forestwide

Key Results

The trend data for deferred maintenance (DM) has continued to rise since our last biennial monitoring report, both in trails and our developed recreation sites. DM costs for developed recreation sites were $8,710,269 and $7,727,273 in 2023 and 2022, respectively. The five-year average deferred developed recreation site maintenance costs (2019-2023) were $6,109,197 (Figure 14). DM costs for trails were $19,892,083 and $18,837,463 in 2023 and 2022, respectively. The five-year average deferred trail maintenance costs were $13,234,997.

Looking at the data for both trails and recreation sites we see a similar trend (Figure 14). Through the 5-year period we saw a consistent increase in DM. The increase was largest in the Seward district. The proportion of DM attributed to trails was higher than that for recreation sites, driven mostly by a large increase in trails DM for the Seward district (Figure 14).

The overall increase in DM is a result of several factors. FY2020 was the rollout of the Great American Outdoors Act, which brought funding into the Forest to address Deferred Maintenance on our assets. Because GAOA funding is specifically tied to DM reduction, we have had to update the DM dollar amounts in Infra to match the project costs and actual costs on the ground, which have increased significantly over the last few years. With increased costs, we can do less work than we anticipated with the amount of funding received, resulting in smaller DM reductions upon project completion. As projects continue to be completed, we believe we will see DM start to go down slightly, but this was a good lesson in accurately capturing costs associated with existing DM and the myriad external factors that can come into play when trying to execute that work.

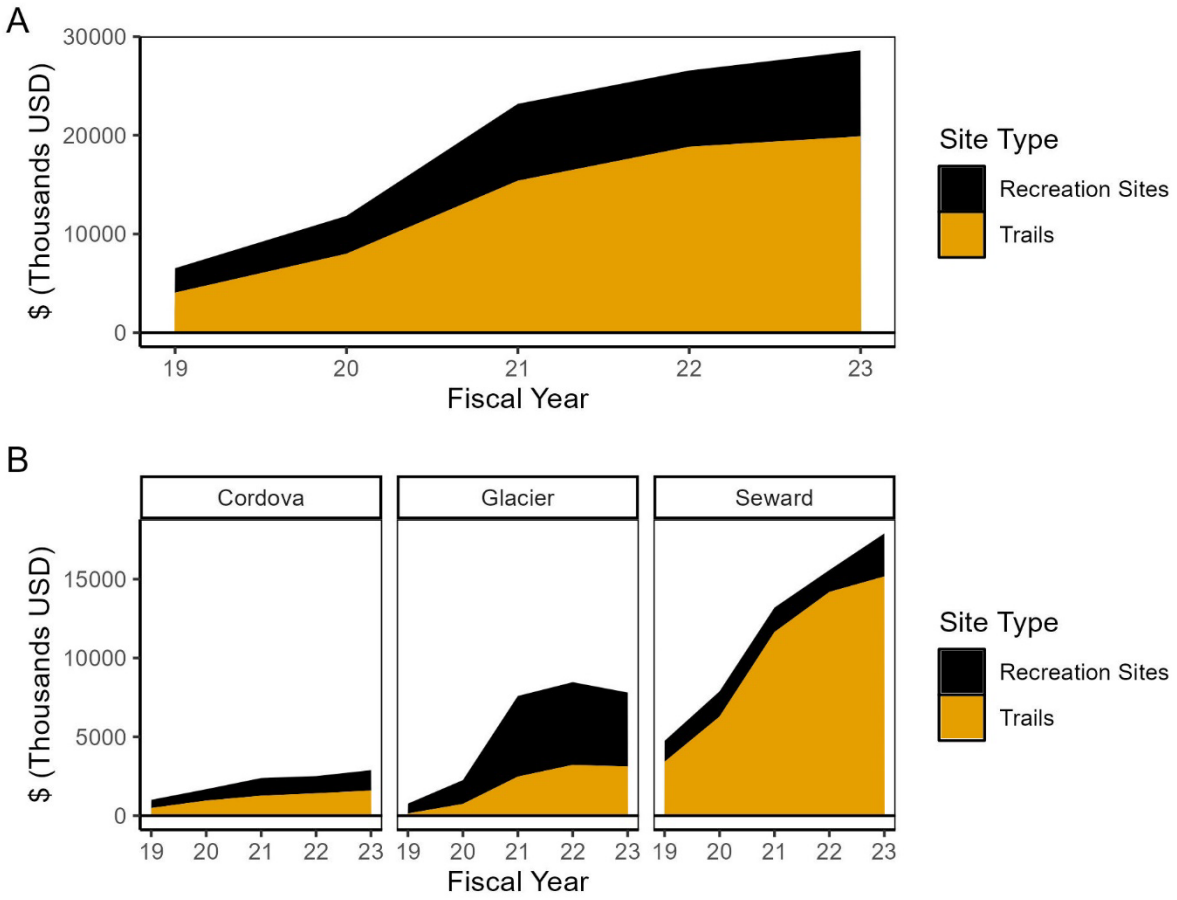

Figure 14. A) Forest-wide deferred maintenance recreation site and trail comparison, and B) maintenance recreation site and trail comparison by district. Recreation sites are displayed in black, trails in orange.

Recommendations

While it's important to have quantifiable data regarding deferred maintenance (as highlighted above), it doesn't tell the entire story. We've continued to see significant cost increases in both materials and labor as well as a decrease in qualified contractors post pandemic. Taking these variables into account has caused us to course correct our costing. Sustainability of our recreation facilities will be realized when timely maintenance reduces how much deferred maintenance is added to the total deferred maintenance each year and existing deferred maintenance is removed by reconstruction of aging facilities. With several years of investment still to come through GAOA and other funding streams, we believe we will continue a path to sustainability.

Table 12. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 5 MI 5.1	Recreation facilities continue to show steady occupancy	We do not need to change forest plan language or management activities.
MQ 5 MI 5.2	We saw a slight increase in the number of outfitter and guides operating between 2022 and 2023. In addition, the last few permit Holders who had went into "Non-Use" during the 2020 pandemic moved back into "issued" status and were operating	We recommend accepting outfitter and guide proposals, on a walk-in basis, for specific activities and locations within eastern Prince William Sound and Copper River. The Forest is seeking to add opportunities for new uses in the Spencer and Grandview Whistle stop areas. The Forest has made determining the appropriate areas and use capacities for small cruise operators in Prince William Sound a priority planning project in 2024.
MQ 5 MI 5.3	Trail miles maintained by partners has steadily increased post-pandemic.	No changes to the forest plan or management actions are recommended.
MQ 5 MI 5.4	The total number of recreation sites operated and maintained by volunteers and partners has remained steady at 13 since 2020.	No changes to the forest plan or management actions are recommended.
MQ 5 MI 5.5	The trend data for deferred maintenance has continued to rise since our last biennial monitoring report, both in trails and our developed recreation sites.	Sustainability of our recreation facilities will be realized when timely maintenance reduces how much deferred maintenance is added to the total deferred maintenance each year and existing deferred maintenance is removed by reconstruction of aging facilities. With several years of investment still to come through GAOA and other funding streams, we will continue a path to sustainability

Climate Change and Other Stressors

The *Climate Change Vulnerability Assessment for the Chugach National Forest and Kenai Peninsula* (CCVA; Hayward et al. 2017) discusses the consequences of modeled climatic changes associated with five key elements and the associated changes in ecological services they provide. This assessment:

> *…explores the potential consequences of climate change for: (a) snowpack, glaciers, and winter recreation; (b) coastal landscapes and associated environments, (c) vegetation, (d) salmon, and (e) a select set of wildlife species. During the next half century, directional change associated with warming temperatures and increased precipitation will result in dramatic reductions in snow cover at low elevations, continued retreat of glaciers, substantial changes in the hydrologic regime for an estimated 8.5 percent of watersheds, and potentially an increase in the abundance of pink salmon. In contrast to some portions of the Earth, apparent sea level rise is likely to be low for much of the assessment region owing to interactions between tectonic processes and sea conditions. Shrubs and forests are projected to continue moving to higher elevations, reducing the extent of alpine tundra and potentially further affecting snow levels. Opportunities for alternative forms of outdoor recreation and subsistence activities that include sled-dog mushing, hiking, hunting, and travel using across-snow vehicles will change as snowpack levels, frozen soils, and vegetation change over time. There was a projected 66-percent increase in the estimated value of human structures (e.g. homes, businesses) that are at risk to fire in the next half century on the Kenai Peninsula, and a potential expansion of invasive plants, particularly along roads, trails, and waterways.*

Chugach National Forest staff used the assessment to guide the selection of monitoring indicators for climate change outlined below.

Monitoring Question 6. Is climate change affecting key ecological functions of terrestrial and aquatic habitats within the national forest?

Indicator 6.1. Changes in hydrographs on selected sites

Key Results

This is the first year that streamflow data have been compiled and summarized for inclusion in the biennial monitoring report (TableTable 13 and Table Table 14). Further statistical analysis will be performed (e.g., ANOVA, t-tests, and simple linear regression) when sufficient data are available to detect temporal trends and make comparisons among streamflow types (i.e., glacier vs. snow-dominated).

Table 13. Mean Daily Discharge Metrics by Site and Water Year. All discharge values are in cubic feet per second and dates are reported as MM-DD in parenthesis.

Name	Watershed Type	Water Year	Annual Mean	Fall Min	Winter Min	Spring Min	Summer Min	Fall Max	Winter Max	Spring Max	Summer Max
Copper River at Million Dollar Bridge near Cordova, AK	glacier-dominant	2021	63000	8830 (11-30)	6010 (2-16)	6010 (3-1)	90900 (6-1)	140000 (9-4)	8720 (12-1)	83700 (5-31)	236000 (6-29)
		2022	NA	NA	NA	NA	122000 (6-1)	NA	NA	NA	262000 (7-12)
		2023	NA	27100 (10-31)	NA	NA	78900 (6-1)	309000 (9-1)	NA	NA	348000 (8-30)
Glacier River Tributary near Cordova, AK	glacial-transitional snow-transitional	2021	16.1	3.3 (11-24)	1.16 (2-26)	0.66 (4-10)	8.08 (8-7)	70.6 (10-3)	71.8 (12-2)	55.7 (5-29)	148 (8-12)
		2022	22.4	2.52 (11-29)	1.24 (1-9)	3.21 (3-23)	12.1 (7-15)	200 (9-9)	27.3 (1-22)	51.9 (5-29)	152 (8-14)
		2023	21	3.21 (11-8)	1.64 (2-28)	1.36 (3-6)	6.63 (8-23)	172 (10-7)	58 (1-25)	61.5 (5-26)	189 (8-13)
West Fork Olsen Bay Creek near Cordova, AK	clearwater snow-dominant	2021	27.3	6.15 (11-24)	0.87 (2-26)	0.34 (3-29)	10.1 (7-23)	136 (10-3)	177 (12-2)	87.9 (5-29)	174 (8-27)
		2022	37.2	5.18 (11-26)	2.77 (1-8)	7.82 (3-1)	14.8 (7-10)	221 (9-9)	7.54 (2-28)	78.9 (5-28)	234 (8-19)
		2023	36.6	6.91 (11-7)	2.61 (2-26)	1.89 (3-16)	19.1 (8-23)	236 (10-16)	93.5 (1-25)	98.4 (5-20)	203 (8-13)
Wolverine Creek near Lawing, AK	glacial-dominant snow-dominant	2021	NA	NA	NA	NA	104 (6-3)	NA	NA	NA	492 (7-12)

Name	Watershed Type	Water Year	Annual Mean	Fall Min	Winter Min	Spring Min	Summer Min	Fall Max	Winter Max	Spring Max	Summer Max
		2022	NA	NA	NA	NA	133 (6-1)	NA	NA	NA	687 (8-17)
		2023	NA	NA	NA	NA	27.7 (6-3)	NA	NA	NA	743 (8-12)
Grouse Creek at Grouse Lake Outlet near Seward, AK	glacier-transitional snow-dominant	2021	16.4	3.04 (9-1)	4.6 (2-28)	2.49 (4-9)	3.19 (8-31)	179 (10-3)	83.4 (12-2)	59.1 (5-20)	55.8 (6-1)
		2022	18.6	4.05 (10-4)	4.08 (1-4)	5.27 (3-23)	6.21 (7-6)	290 (10-31)	17.5 (1-25)	57.4 (5-22)	46 (8-20)
		2023	18.4	11.1 (11-6)	4.2 (2-26)	3.5 (3-14)	9.8 (8-23)	118 (10-9)	15.7 (1-4)	75.5 (5-20)	123 (8-29)
Snow River near Seward, AK	glacier-dominant/ high elevation melt	2021	1250	114 (11-17)	60.9 (2-28)	56.3 (4-9)	1130 (8-29)	20000 (11-4)	709 (12-2)	1650 (5-31)	5470 (7-12)
		2022	1270	158 (11-30)	55.5 (2-26)	54.5 (3-14)	1620 (6-1)	22200 (9-5)	145 (12-1)	1630 (5-30)	8410 (8-17)
		2023	1230	145 (11-30)	67.7 (2-25)	57.5 (4-9)	735 (6-3)	23600 (9-9)	143 (12-1)	1990 (5-20)	6190 (8-29)
Kenai River at Cooper Landing, AK		2021	2930	1010 (11-29)	439 (2-28)	338 (4-13)	3650 (8-31)	13500 (10-4)	1250 (12-4)	4900 (5-31)	8280 (6-26)
		2022	3090	1020 (11-30)	400 (2-28)	329 (3-22)	5030 (6-1)	12900 (9-6)	1000 (12-1)	4730 (5-31)	9670 (8-21)
		2023	3290	1110 (11-30)	588 (2-28)	379 (4-9)	4230 (6-5)	12700 (9-10)	1090 (12-2)	4920 (5-29)	9330 (6-26)
Cooper Creek at Mouth	Clearwater /snow-dominant	2021	36.7	16.4 (11-30)	9.85 (2-28)	6.13 (4-6)	11.9 (8-13)	264 (10-3)	19.8 (12-9)	133 (5-27)	142 (6-7)

Name	Watershed Type	Water Year	Annual Mean	Fall Min	Winter Min	Spring Min	Summer Min	Fall Max	Winter Max	Spring Max	Summer Max
Near Cooper Landing, AK											
		2022	35.5	21.9 (10-17)	10.7 (1-31)	8.81 (4-4)	35.2 (8-16)	221 (10-31)	22.9 (12-1)	136 (5-30)	146 (6-5)
		2023	34.1	22 (11-29)	15.7 (1-19)	16.4 (3-10)	37 (8-23)	65.1 (10-9)	22 (12-2)	95.2 (5-20)	82.7 (6-9)
Sixmile Creek near Hope, AK	glacier-transitional snow-dominant	2021	815	253 (11-29)	140 (2-21)	83.6 (4-9)	599 (8-22)	3470 (10-2)	288 (12-2)	2710 (5-27)	3100 (6-15)
		2022	897	232 (11-29)	128 (2-28)	104 (4-9)	951 (8-7)	2340 (10-31)	234 (12-6)	2970 (5-30)	3810 (6-5)
		2023	866	275 (11-30)	136 (2-12)	137 (3-1)	785 (8-23)	1600 (9-17)	272 (12-1)	2900 (5-26)	3690 (6-22)
Glacier Creek at Alyeska Highway at Girdwood, AK	glacier-transitional snow-dominant	2021	201	53.1 (11-18)	24.1 (2-20)	17.6 (4-9)	202 (8-16)	2500 (10-2)	292 (1-18)	495 (5-30)	780 (6-25)
		2022	262	48.6 (11-28)	26.2 (1-9)	25.9 (3-23)	356 (7-14)	1440 (10-31)	83.3 (1-24)	474 (5-30)	1560 (8-17)
		2023	256	56.2 (11-29)	19.9 (2-26)	21 (4-9)	261 (8-22)	941 (9-16)	107 (1-2)	751 (5-26)	2210 (8-26)

Table 14. Monthly and Annual Total Mean Daily Discharge by Site and Water Year. All discharge values are in cubic feet per second and Parde coefficients are in parenthesis. RBI = Richards-Baker Index.

Name	Watershed Type	Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	RBI
Copper River at Million Dollar Bridge near Cordova, AK	glacial-dominant	2021	1300000 (0.7)	346000 (0.2)	229000 (0.1)	189000 (0.1)	168000 (0.1)	199000 (0.1)	418000 (0.2)	1510000 (0.8)	4620000 (2.4)	5810000 (3)	5550000 (2.8)	2670000 (1.4)	23000000	0.046
		2022	706000	NA	NA	NA	NA	NA	NA	NA	5150000	6420000	5890000	4530000	NA	NA
		2023	2890000	NA	NA	NA	NA	NA	NA	NA	4300000	6960000	6650000	4250000	NA	NA
Glacier River Tributary near Cordova, AK	glacial-transitional snow-transitional	2021	534 (1.1)	194 (0.4)	407 (0.8)	288 (0.6)	49.8 (0.1)	31.5 (0.1)	319 (0.7)	827 (1.7)	1110 (2.3)	663 (1.3)	900 (1.8)	534 (1.1)	5860	0.33
		2022	496 (0.7)	384 (0.6)	62.2 (0.1)	244 (0.4)	191 (0.3)	145 (0.2)	224 (0.3)	952 (1.4)	1060 (1.6)	1100 (1.6)	1400 (2)	1920 (2.9)	8180	0.35
		2023	1240 (1.9)	353 (0.6)	183 (0.3)	390 (0.6)	71.9 (0.1)	73.7 (0.1)	171 (0.3)	935 (1.4)	1340 (2.1)	552 (0.8)	1390 (2.1)	962 (1.5)	7660	0.43
West Fork Olsen Bay Creek near Cordova, AK	clearwater snow-dominant	2021	1130 (1.3)	353 (0.4)	791 (0.9)	565 (0.7)	84.3 (0.1)	31.9 (0)	705 (0.9)	1540 (1.8)	1520 (1.9)	740 (0.9)	1590 (1.9)	923 (1.1)	9980	0.28
		2022	788 (0.7)	650 (0.6)	113 (0.1)	89.2 (0.1)	118 (0.1)	358 (0.3)	944 (0.8)	1620 (1.4)	1350 (1.2)	1640 (1.4)	3000 (2.6)	2900 (2.6)	13600	0.27
		2023	2120 (1.9)	739 (0.7)	255 (0.2)	698 (0.6)	218 (0.2)	166 (0.1)	484 (0.4)	1700 (1.5)	1980 (1.8)	1710 (1.5)	2040 (1.8)	1250 (1.1)	13400	0.32
Wolverine Creek near Lawing, AK	glacial-dominant snow-dominant	2021	NA	NA	NA	NA	NA	NA	NA	NA	6040	894	8060	444	NA	NA
		2022	426	NA	NA	NA	NA	NA	NA	NA	665	10000	10100	457	NA	NA
		2023	NA	NA	NA	NA	NA	NA	NA	NA	514	9460	11800	3880	NA	NA
Grouse Creek at Grouse Lake	glacier-transitional	2021	990 (1.9)	278 (0.6)	755 (1.5)	583 (1.1)	203 (0.4)	104 (0.2)	352 (0.7)	1410 (2.8)	822 (1.7)	240 (0.5)	126 (0.2)	136 (0.3)	5990	0.13

Name	Watershed Type	Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	RBI
Outlet near Seward, AK	snow-dominant															
		2022	663 (1.2)	1120 (2)	214 (0.4)	225 (0.4)	193 (0.4)	218 (0.4)	402 (0.7)	1350 (2.3)	594 (1.1)	285 (0.5)	609 (1.1)	904 (1.6)	6780	0.17
		2023	1030 (1.8)	542 (1)	289 (0.5)	302 (0.5)	173 (0.3)	136 (0.2)	164 (0.3)	1270 (2.2)	828 (1.5)	593 (1)	727 (1.3)	652 (1.2)	6710	0.14
Snow River near Seward, AK		2021	65600 (1.7)	59000 (1.6)	7130 (0.2)	4190 (0.1)	2030 (0.1)	1800 (0)	6240 (0.2)	25800 (0.7)	80800 (2.2)	103000 (2.7)	63500 (1.6)	35700 (1)	455000	0.24
		2022	19000 (0.5)	15000 (0.4)	3450 (0.1)	2640 (0.1)	1740 (0)	2140 (0.1)	4820 (0.1)	24700 (0.6)	74100 (1.9)	93300 (2.4)	106000 (2.7)	116000 (3)	463000	0.26
		2023	42700 (1.1)	6380 (0.2)	3900 (0.1)	3110 (0.1)	2100 (0.1)	2280 (0.1)	2060 (0.1)	25700 (0.7)	66500 (1.8)	103000 (2.7)	101000 (2.7)	89700 (2.4)	449000	0.28
Kenai River at Cooper Landing, AK		2021	168000 (1.9)	72300 (0.8)	34300 (0.4)	27000 (0.3)	16100 (0.2)	12200 (0.1)	14100 (0.2)	85300 (0.9)	202000 (2.3)	203000 (2.2)	139000 (1.5)	96700 (1.1)	1070000	0.046
		2022	41400 (0.4)	79700 (0.9)	23800 (0.2)	15600 (0.2)	12900 (0.1)	10900 (0.1)	12400 (0.1)	60100 (0.6)	214000 (2.3)	236000 (2.5)	218000 (2.4)	198000 (2.1)	1120000	0.046
		2023	140000 (1.4)	41100 (0.4)	28900 (0.3)	24600 (0.2)	18000 (0.2)	14600 (0.1)	12200 (0.1)	71400 (0.7)	190000 (1.9)	255000 (2.5)	215000 (2.1)	193000 (2)	1200000	0.046
Cooper Creek at Mouth Near Cooper Landing, AK		2021	2060 (1.8)	929 (0.8)	511 (0.4)	376 (0.3)	326 (0.3)	290 (0.3)	723 (0.7)	2840 (2.5)	2950 (2.7)	672 (0.6)	726 (0.6)	998 (0.9)	13400	0.079
		2022	1260 (1.1)	1340 (1.3)	534 (0.5)	388 (0.4)	313 (0.3)	321 (0.3)	437 (0.4)	2290 (2.1)	2320 (2.2)	1310 (1.2)	1230 (1.2)	1190 (1.1)	12900	0.075
		2023	1160 (1.1)	741 (0.7)	629 (0.6)	534 (0.5)	476 (0.5)	516 (0.5)	544 (0.5)	1920 (1.8)	1830 (1.8)	1690 (1.6)	1250 (1.2)	1160 (1.1)	12400	0.044
Sixmile Creek near Hope, AK	glacier-transitional snow-dominant	2021	33300 (1.3)	8520 (0.3)	7130 (0.3)	5820 (0.2)	4330 (0.2)	3870 (0.2)	11500 (0.5)	53300 (2.1)	78300 (3.2)	49900 (2)	24000 (1)	17400 (0.7)	297000	0.069
		2022	19300 (0.7)	17800 (0.7)	6850 (0.2)	5290 (0.2)	3870 (0.2)	3590 (0.1)	5250 (0.2)	39500 (1.4)	93000 (3.5)	55500 (2)	43800 (1.6)	32600 (1.2)	326000	0.076

Name	Watershed Type	Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual	RBI
		2023	26800 (1)	11700 (0.4)	7860 (0.3)	6790 (0.3)	3910 (0.2)	4540 (0.2)	5090 (0.2)	45400 (1.7)	77000 (3)	61100 (2.3)	36200 (1.4)	29700 (1.1)	316000	0.089
Glacier Creek at Alyeska Highway at Girdwood, AK	glacier-transitional snow-dominant	2021	10400 (1.7)	2230 (0.4)	2530 (0.4)	2370 (0.4)	819 (0.1)	679 (0.1)	3100 (0.5)	9050 (1.5)	14500 (2.4)	13600 (2.2)	8210 (1.3)	5790 (1)	73200	0.14
		2022	6340 (0.8)	4260 (0.5)	1290 (0.2)	1260 (0.2)	929 (0.1)	1120 (0.1)	2110 (0.3)	8630 (1.1)	17200 (2.2)	15700 (1.9)	23700 (2.9)	13200 (1.7)	95700	0.16
		2023	8340 (1.1)	3000 (0.4)	1900 (0.2)	1820 (0.2)	896 (0.1)	882 (0.1)	993 (0.1)	9840 (1.2)	16400 (2.1)	19500 (2.5)	16700 (2.1)	13200 (1.7)	93500	0.18

Recommendations

We have no recommended changes currently.

Indicator 6.2. Tree and shrub encroachment in alpine habitat and recently deglaciated areas

Key Results

- An increase in tall shrub cover can be an indicator of early succession post glaciation and encroachment into climax alpine habitats. While all three districts saw an increase (Figure 15 and Figure 16) in tall shrub cover over 1987-2022, these increases are within the margin of error at the district scale. However, a significant increase in tall shrub cover was detected at the HUC 6 watershed scale on the Kenai Peninsula coupled with a significant decrease in trees (Figure 17). Most of this change occurred on non-NFS lands on the northwestern Kenai on the Kenai Wildlife Refuge.
- Vice versa, a decrease in shrubs coupled with an increase in tall shrubs and trees can indicate encroachment in the alpine. There was no significant decrease in shrubs at any available scale for analysis.
- On the forest, the largest proportional change in landcover was seen in snow and ice cover over the 35-year period. The Glacier District, which harbors the highest amount of snow and ice, saw the greatest reduction, but this change was still within the margin of error.
- Changes in vegetation and snow cover were seen along anticipated trajectories for the districts, as well as forest-wide, however, those changes were all within the margin of error for the 35-year analysis period. Landscape level change, as detected by remote sensing imagery and modeling, is likely occurring at measurable and statistically significant time scales outside the available imagery period, and well outside the planning period timeframe.

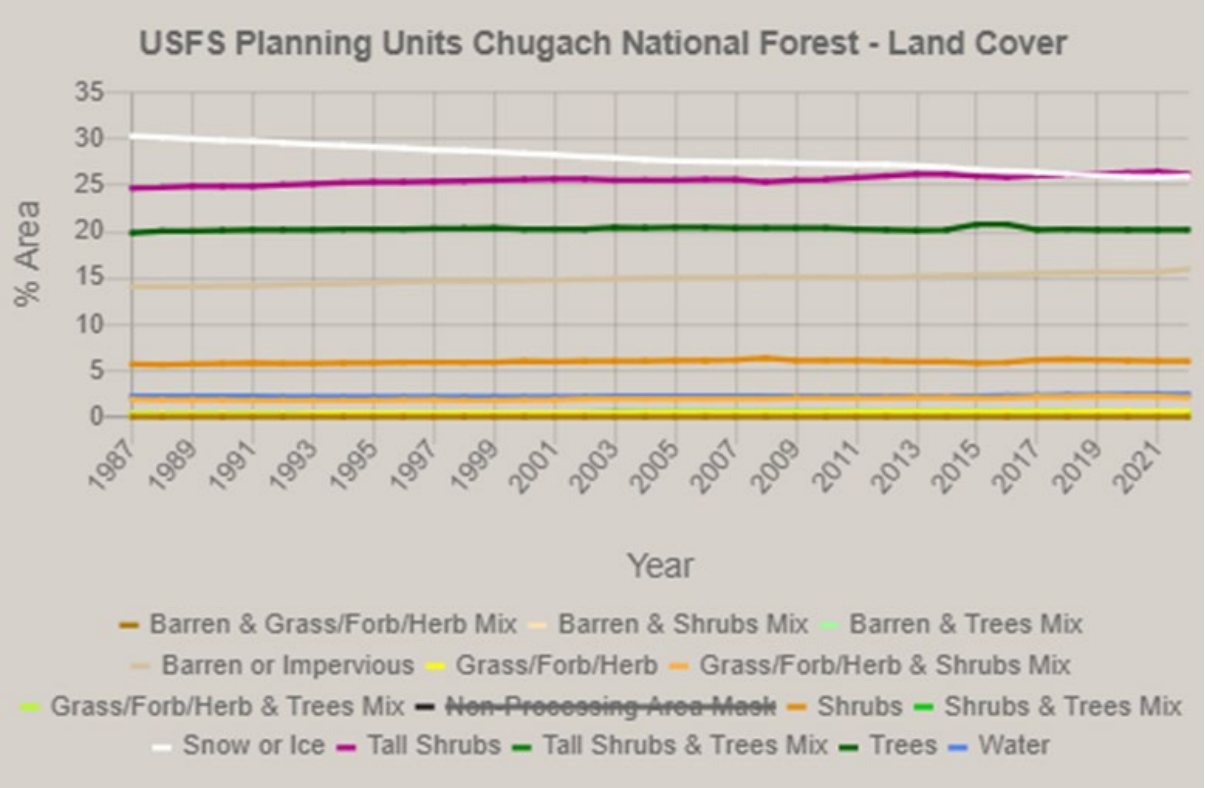

Figure 15. Summary graph of % change in area by landcover class from 1987-2022 on the Chugach National Forest. Landcover types are differentiated by color.

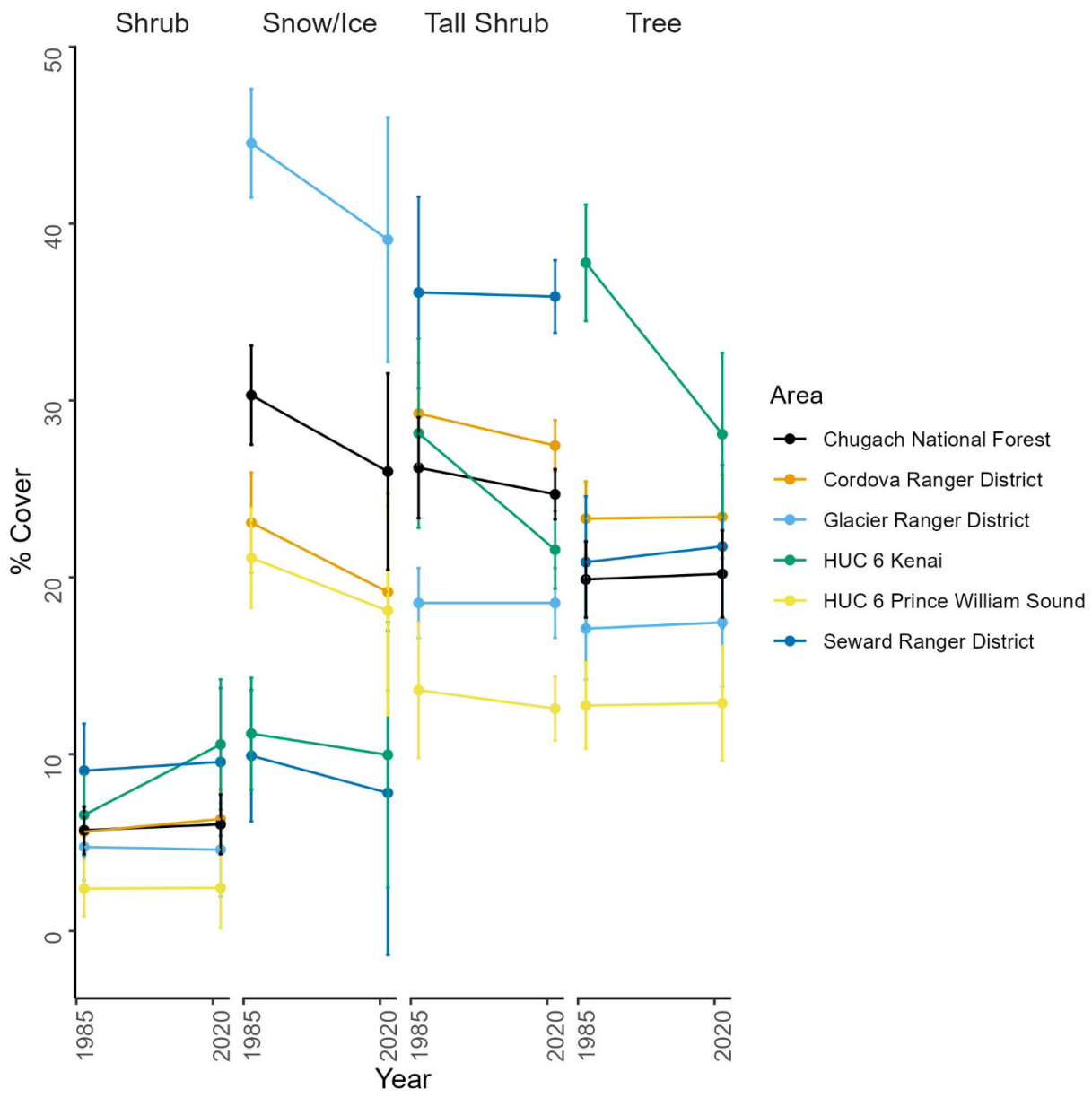

Figure 16. Percent of area by key landcover type indicators across different summary areas covering the Chugach National Forest. Summary areas are differentiated by color. Values are displayed as mean ± sd. LCMS Dashboard Disclaimer: All summary numbers are based on modeled LCMS outputs.

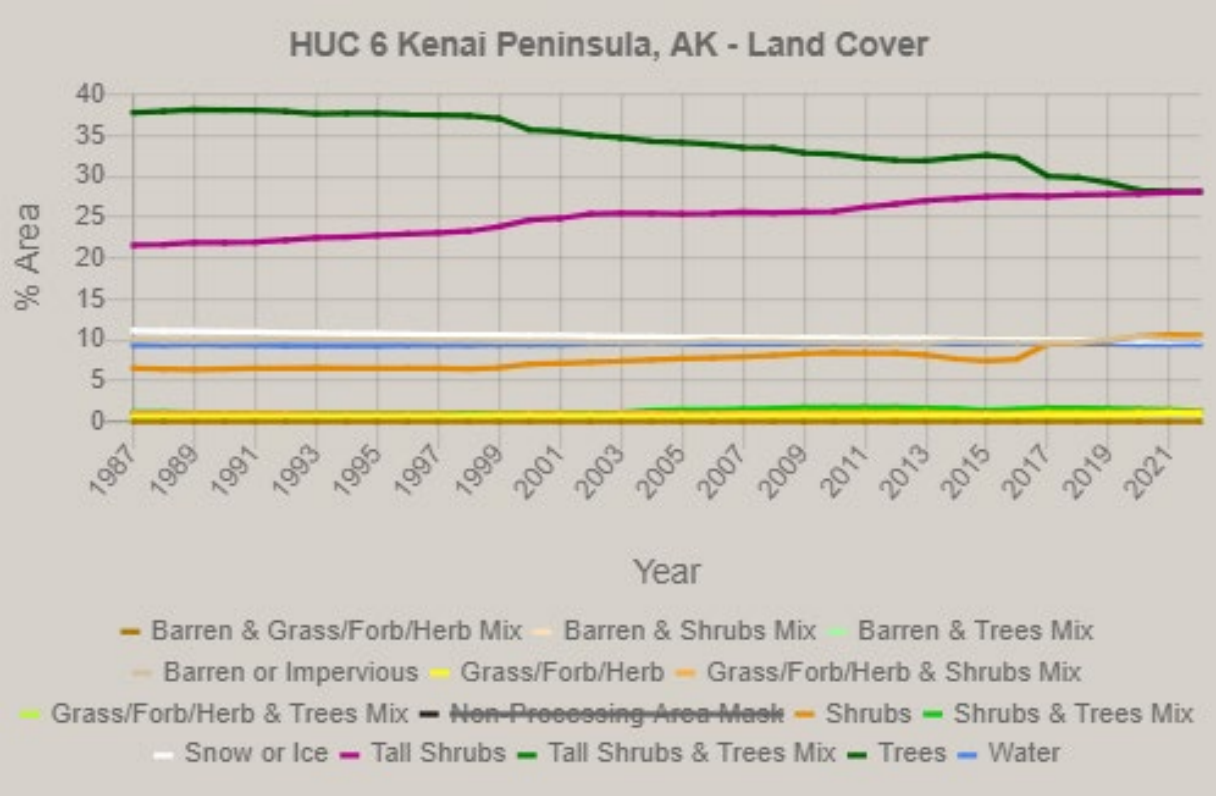

Figure 17. Summary graph of % change in area by landcover class from 1987-2022 for the HUC 6 Kenai Peninsula, the only analysis area with significant land cover change. Landcover types are differentiated by color.

Recommendations

- Map data and imagery used to model change in the LCMS dashboard should be updated prior to the next analysis period.
- Data from 1985 and 1986 should be excluded from future analysis due to sizable anomalies.
- Change detection analyses should be done on predetermined key areas of the forest where change is likely occurring more rapidly and could be detected as significant at these smaller scales (Kenai mountains, northern Prince William Sound). The LCMS tool currently cannot summarize statistics from areas smaller than districts, so alternative tools or modification of the LCMS tool for smaller scale analysis should be explored.
- The amount of snow and ice loss occurring in the Prince William Sound geographic area is likely significant, however, the timing of when cloud free imagery is available for annual comparisons is highly variable and can increase the margin of error. Alternative methods for assessing snow/ice loss, such as photo points, should be explored.

Indicator 6.3. Changes in water temperature on selected sites

Key Results

Stream temperature data for the water year 2020 to 2023 were compiled and summarized for inclusion in this biennial monitoring report (Table 15 and Table 16). Data presented are from a subset of sites

monitored by the Chugach National Forest as not all datasets have been checked for quality and entered in the appropriate databases.

Table 15. Mean Daily Temperature Metrics by Site and Water Year[1]

Name	Watershed Type	Water Year	Annual Mean	Fall Mean	Winter Mean	Spring Mean	Summer Mean
Glacier River tributary near Cordova	glacial-transitional snow-transitional	2021	3.4	4.5	1.6	1.7	5.8
		2022	3.5	4.4	1.2	2.4	6.1
		2023	3.7	5.1	1.6	1.9	6.3
West Fork Olsen Bay Creek near Cordova	clearwater snow-dominant	2021	4	5.1	1.3	1.9	7.5
		2022	4	4.9	0.7	2.6	7.8
		2023	4	5.4	1.2	1.8	7.4
Bench Creek	glacial-dominant	2021	2.9	2.8	0.4	1.5	6.7
		2022	2.9	2.9	0.3	1.9	6.5
		2023	2.9	3	0.3	1.5	6.7
Center Creek	glacial-dominant	2023	2.5	NA	0.2	0.9	6.1
Chickaloon Headwaters	lake/ground water	2021	6	NA	1.4	NA	13.8
		2022	NA	3.2	1.4	1.1	NA
Crescent Creek	lake/ground water	2022	4.6	NA	0.6	2.6	11

[1]All temperature values are in degrees Celsius

Table 16. Additional Mean Daily Temperature Metrics by Site and Water Year

Name	Watershed Type	Water Year	Min 7-Day Avg	Fall Min	Win Min	Spr Min	Sum Min	Max 7-Day Avg	Fall Max	Win Max	Spr Max	Sum Max
Glacier River tributary near Cordova	glacial-transitional snow-transitional	2021	0.3	0.8	0.1	0.1	3.1	7.7	8.3	2.6	3.5	8
		2022	0.1	0.1	0.1	1.5	3.5	8	8.2	2.3	3.5	8.6
		2023	0.3	0.6	0	0.1	3.4	8.7	8.3	2.8	3.5	9.5
West Fork Olsen Bay Creek near Cordova	clearwater snow-dominant	2021	0.2	1.1	0.2	0.1	4.4	9.1	8.7	2.8	4.9	9.4
		2022	0.1	0.4	0.1	1.1	5.2	9	8.6	1.8	5.1	9.3
		2023	0.2	0.6	0.2	0	4.2	9.4	9.1	2.2	4	10.1

Name	Watershed Type	Water Year	Min 7-Day Avg	Fall Min	Win Min	Spr Min	Sum Min	Max 7-Day Avg	Fall Max	Win Max	Spr Max	Sum Max
Bench Creek	glacial-dominant	2021	0.1	0.1	0.1	0	3.2	9.3	7.9	1.3	3.6	9.5
		2022	0	0	0	0	4	8.3	7.2	1.3	3.9	9
		2023	0	0	0	0	3.3	9.7	8	1.4	3.6	10.1
Center Creek	glacial-dominant	2023	0.1	NA	0.1	0.1	2.6	8.8	NA	1.3	2.9	9.1
Chickaloon Headwaters	lake/ground water	2021	0.9	1.9	0.9	0.8	8.9	16.5	12.8	2.2	9.3	17.1
		2022	NA	NA	1.1	NA	NA	NA	NA	1.7	NA	NA
Crescent Creek	lake/ground water	2022	0	NA	0	0	8.7	12.8	NA	1.5	8.3	13.4

Recommendations

We have no recommended changes to the forest plan components or management activities.

Indicator 6.4. Snow depth, season of snow cover

Key Results

SNOTEL data for the water years 2020 to 2023 were compiled and summarized for inclusion in this biennial monitoring report (Table 17 and Table 18). Further statistical analysis will be performed (e.g., ANOVA, t-tests, and simple linear regression) when sufficient data are available to detect temporal trends and make comparisons among streamflow types (i.e., glacier vs. snow-dominated).

Table 17. *Chugach National Forest SNOTEL Site Information. Data from: https://www.wcc.nrcs.usda.gov/snow/snow_map.html#:~:text=https%3A//www.nrcs.usda.gov/wps/portal/wcc/home/quicklinks/predefinedMaps/*

Id	Name	Elevation (m)	HUC12 (12-digit)	Latitude, Longitude	County
1103	Mt. Alyeska	470	190203020702	60.95983, -149.08617	Anchorage
1070	Anchorage Hillside	634	190204010601	61.11483, -149.66683	Anchorage
946	Indian Pass	716	190204010402	61.06767, -149.4795	Anchorage
966	Kenai Moose Pens	91	190203021601	60.727, -150.47517	Kenai Peninsula
987	Port Graham	91	190203011208	59.35065, -151.84768	Kenai Peninsula
1092	Exit Glacier	122	190202020508	60.19033, -149.62117	Kenai Peninsula
964	Grouse Creek Divide	213	190203020902	60.25965, -149.34228	Kenai Peninsula
956	Grandview	335	190203021001	60.60832, -149.06313	Kenai Peninsula
959	Cooper Lake	366	190203021205	60.39027, -149.6936	Kenai Peninsula

Id	Name	Elevation (m)	HUC12 (12-digit)	Latitude, Longitude	County
1003	Mcneil Canyon	402	190203010806	59.74433, -151.25133	Kenai Peninsula
955	Summit Creek	427	190203020401	60.61713, -149.53128	Kenai Peninsula
1062	Anchor River Divide	504	190203010701	59.85972, -151.315	Kenai Peninsula
954	Turnagain Pass	573	190203020406	60.78043, -149.18325	Kenai Peninsula
1073	Mt. Eyak	428	190202010200	60.55, -145.745	Valdez-Cordova
1096	May Creek	491	190201031603	61.34783, -142.70967	Valdez-Cordova
1055	Upper Tsaina River	534	190201040203	61.19112, -145.64807	Valdez-Cordova

Table 18. Maximum SWE in October and November Recorded at SNOTEL Sites in Chugach National Forest. All SWE values are in inches.

SNOTEL Station				October					November		
Name	Elev. (m)	2020	2021	2022	2023	Avg. 1971-2000	2020	2021	2022	2023	Avg. 1971-2000
Indian Pass	716	3.6	7.1	1.7	0.5	3	10.4	11.6	5.6	7.8	7.4
Turnagain Pass	573	1	7.3	0.8	0.3	2.4	10.7	14.6	5.5	9.6	7.6
Summit Creek	427	0.2	2.1	0.7	0	1	4	3.2	3.1	5.5	2.9
Grandview	335	0	3.6	0.7	0.2	1.4	7	6.5	4.3	7.8	4.4
Cooper Lake	366	0	1.1	0.5	0	0.9	5.3	1.3	3.4	4.9	4
Grouse Creek Divide	213	0	1.7	0	0	0.5	7	3	4.2	5.6	2.1
Kenai Moose Pens	91	0.1	0.2	0.4	0	0.7	1.1	0.9	2.3	3	1.3
Port Graham	91	0	0.7	0	0	0.4	1.8	4.6	1.8	0	1.2
Mcneil Canyon	402	0.2	0.5	0.4	0	0.6	3.8	1.3	2.1	2.8	2.2
Upper Tsaina River	534	0.9	0.9	3	0.4	1.4	3.4	3	5.9	8.4	6.3
Anchor River Divide	504	1.2	0.8	0.6	0	0.7	5.2	2.2	3.3	4	2.9
Anchorage Hillside	634	2.6	3.3	0.7	0.3	1	5.9	4.5	2.8	4.8	2.8
Mt. Eyak	428	0.3	2	NA	0	1.4	6.6	5.5	NA	3	5
Exit Glacier	122	0	1.6	0.5	0	NA	5.2	2.5	3.9	3	NA
May Creek	491	1.5	0.8	3	0.5	1	2.3	1.3	3.2	2	2
Mt. Alyeska	470	1	3.9	0.8	0.5	2.1	11	7.3	4.9	8.8	7.2

Recommendations

Recommended actions and next steps are provided in Table 19.

Table 19. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps.

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 6 MI 6.1	This is the first year that streamflow data have been compiled and summarized for inclusion in the biennial monitoring report (Tables 13 and 14).	We have no recommended changes currently.
MQ 6 MI 6.2	Changes in vegetation and snow cover were seen along anticipated trajectories for the districts, as well as forest-wide, however, those changes were all within the margin of error for the 35-year analysis period.	• Map data and imagery used to model change in the LCMS dashboard should be updated prior to the next analysis period. • Data from 1985 and 1986 should be excluded from future analysis due to sizable anomalies. • Change detection analyses should be done on predetermined key areas on the forest where change is likely occurring more rapidly
MQ 6 MQ 6.3	Stream temperature data for the water year 2020 to 2023 were compiled and summarized for inclusion in this biennial monitoring report (Tables 15 and 16).	We have no recommended changes currently.
MQ 6 MI 6.4	SNOTEL data for the water years 2020 to 2023 were compiled and summarized inclusion in this biennial monitoring report (Table 18).	Further statistical analysis will be performed (e.g., ANOVA, t-tests, and simple linear regression) when sufficient data are available to detect temporal trends and make comparisons among streamflow types (i.e., glacier vs. snow-dominated).

Desired Conditions Including Social, Cultural, and Economic Sustainability

Monitoring for sustainable goods and services addresses six forest-wide desired conditions in the 2020 land management plan. We addressed the management question: Is the national forest providing a sustainable, predictable level of goods and services to communities? Chugach National Forest staff selected six indicators to determine trends in conditions for sustainable goods and services (described below).

Positive or stable trends will indicate the Forest Service is making these commodities available; negative trends may indicate funding or staffing shortages or a change in priorities for funding and staffing, or possibly the availability of the resources may be changing (such as mineral materials) which may affect the long-term sustainability of making the good or service available to the local community.

If we find negative trends during assessment of these indicators, we should consider the following management responses:

- Re-evaluate the funding and priorities of the budget as well as staffing decisions and determine if additional resources (budget and employees) are needed for issuance of permits that are showing a negative trend.
- Determine if additional land management plan objectives are needed to focus effort on any aspect that is showing a negative trend.
- Determine if there is a limiting factor for making these resources available to the local communities that is beyond what is possible to change in the land management plan, budget, or staffing (for example, no additional locations available for mineral material pit development, therefore less material available).

Monitoring Question 7. Is the national forest providing a sustainable, predictable level of goods and services to communities?

Indicator 7.1. Trends in number of commercial recreation permits issued

Key Results

Information for trends in developed recreation and recommendation for change is reported in Section 5, Summary for Visitor Use under the Key Result: Special Use Programs -Number of outfitter guide permits issued and administered, activities, locations.

Indicator 7.2. Trends in developed recreational facility use

Key Results

Information for trends in developed recreation and recommendation for change is reported in Section 5. Summary for Visitor Use for the Key Result: Recreation Facility Occupancy Rate.

Indicator 7.3. Trends in number of forest product permits issued

Key Results

Forest product permits have remained within the expected ranges over the last 8 years (Figure 18), showing that we have been able to adequately provide forest products to the public and commercial entities consistently over the monitoring period. The fluctuations observed are expected variations as needs of the communities change and offerings from the Forest Service vary. 2017 and 2018 saw large

fuelwood offerings from the Forest Service to dispose of material from vegetation management activities. 2023 saw an expected spike as the Forest Service began disposing of wood from the Spruce Beetle Strategic Response. Over the last 8 years we have averaged approximately 215 permits per year and have fulfilled over 1500 permits total. We have been able to fulfill all requests for permits.

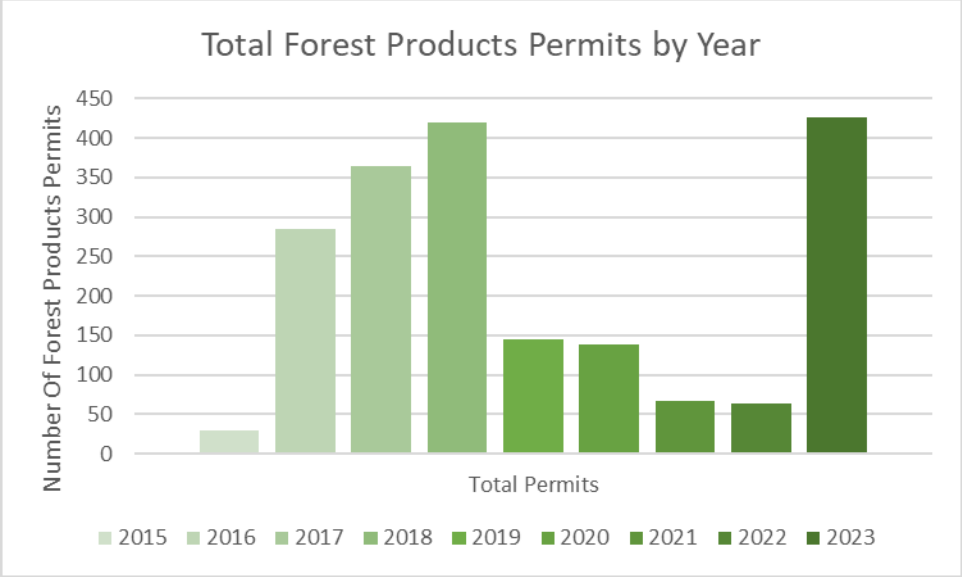

Figure 18. Chugach forest products permits issued by year

The primary categories for forest products permits are fuelwood and commercial special forest products. Over the last 8 years, the Forest Service has issued a total of 1869 fuelwood permits totaling 5821 cords, averaging 373 permits per year and 1164 cords, indicating a relatively steady supply of fuelwood to our communities (Figure 19). The annual fluctuation in permits and cords reflects variation in vegetation management activities.

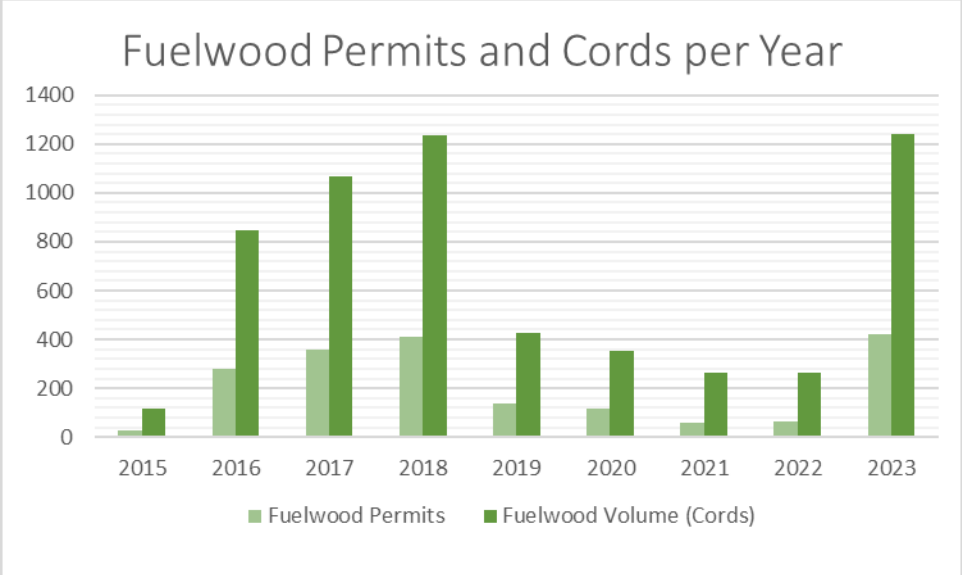

Figure 19. Fuelwood permits (light bars) and cords (dark bars) per year collected on the Chugach National Forest. Permits are shaded lighter than volume.

The number of commercial special forest products permits has remained steady (Figure 20), except for 2020, where the number of commercial permits for mushroom harvesting increased dramatically following the 2019 Swan Lake Fire. This fluctuation is within the expected range of occurrences. The other metrics for commercial special forest products are very consistent over the last 8 years.

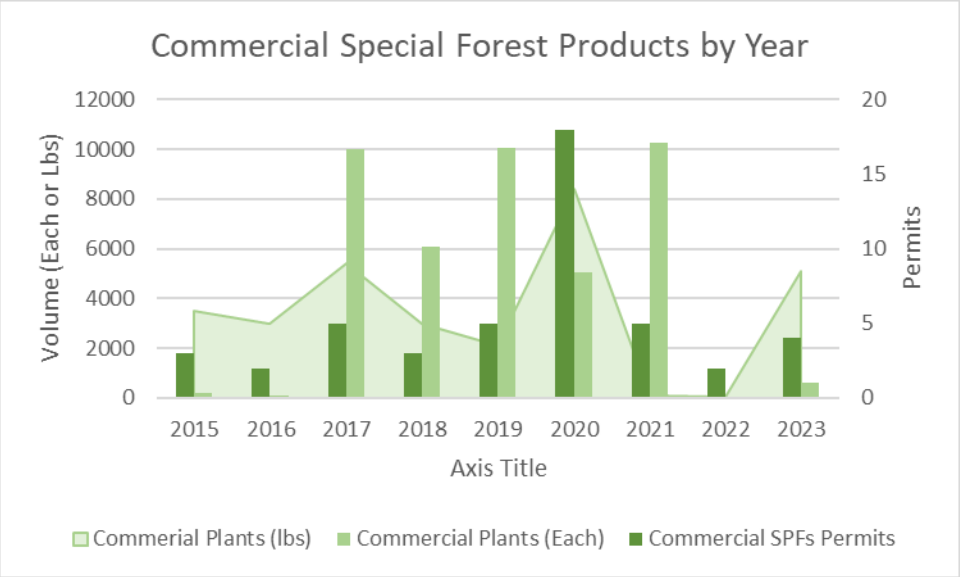

Figure 20. Commercial special forest product permits (dark bars) and weights (light bars) per year collected on the Chugach National Forest. Commercial plants (lbs), plants (units), and spfs are differentiated by increasingly darker shades of green, respectively.

Recommendations

Based on these results, we are not recommending any changes.

Indicator 7.4. Trends in sport fishing harvest

Key Results

Kenai Peninsula Zone

Overall, 2022 harvest and catch from the seven Kenai Peninsula Zone monitoring streams were below average for arctic grayling, Dolly Varden, coho salmon, and rainbow trout (Table 21). Harvest and catch were slightly below average for pink and sockeye salmon. The chum salmon 2022 harvest was above average, but the 2022 catch was near average. Sockeye salmon harvest and catch in the Kenai Peninsula Zone predominantly occurs on the Russian River, which experienced a substantial peak in sockeye catch and harvest in 2019 (Figure 21). The 2022 Russian River sockeye harvest and catch was comparable with all other years in the preceding 10-year period. Fewer than half the 10-year average catch of both Dolly Varden and rainbow trout were caught in 2022 in the Kenai Peninsula Zone streams (Table 22). While there has been some variability in harvest and catch rates in the preceding 10 years, Dolly Varden and rainbow trout catch are on a downward trend, although the harvest data are more variable. Approximately 85% of Kenai Peninsula Zone rainbow trout are caught on the Russian River, while Dolly Varden are predominantly caught on both the Russian River and Quartz Creek. Coho salmon harvest and catch were below average in 2022. Coho catches occur on all monitored waterbodies included in this report other than Crescent Lake. 2022 Coho harvest and catch in Kenai Peninsula Zone streams was the lowest it has been during the preceding 10-year period (Figure 22).

Table 20. Locations and species monitored for the Kenai Peninsula Zone and Prince William Sound Zone sportfish harvest and catch.

Location	Species
Kenai Peninsula Zone[1]	
Russian River	Coho salmon, pink salmon, sockeye salmon, Dolly Varden, rainbow trout
Resurrection Creek	Chum salmon, coho salmon, pink salmon
Sixmile Creek	Chum salmon, coho salmon, pink salmon, Dolly Varden, rainbow trout
Quartz Creek	Dolly Varden, rainbow trout
Crescent Lake	Arctic grayling, rainbow trout
Kenai Lake	Dolly Varden, rainbow trout
Twentymile River	Coho salmon, pink salmon, Dolly Varden
Prince William Sound Zone[2]	
Alaganik Slough	Coho salmon, sockeye salmon, Dolly Varden
Eyak River	Coho salmon, pink salmon, sockeye salmon, cutthroat trout
Ibeck Creek	Coho salmon, cutthroat trout, Dolly Varden

1 – Alaska Sport Fishing Survey areas PF and L.
2 – Alaska Sport Fishing Survey area J.

Table 21. 10-year average (2013-2022) and 2022 harvest and catch by species in Kenai Peninsula Zone and Prince William Sound Zone streams.

Location	10-Year Avg Harvest	2022 Harvest	10-Year Avg Catch	2022 Catch
Kenai Peninsula Zone				
Arctic Grayling	175	0	2,029	743
Chum Salmon	183	564	699	690
Coho Salmon	5,225	3,342	8,692	3,358
Dolly Varden	409	241	20,910	10,418
Pink Salmon	3,293	3,016	17,188	12,286
Rainbow Trout	550	222	25,767	11,906
Sockeye Salmon	45,168	40,938	70,101	64,513
Prince William Sound Zone				
Coho Salmon	13,002	6,719	21,456	9,876
Cutthroat Trout	49	0	296	287
Dolly Varden	367	168	2,899	744
Pink Salmon	239	26	1,001	26
Sockeye Salmon	388	1,512	795	1,709

Table 22. 2022 effort and catch from seven Kenai Peninsula Zone and three Prince William Sound Zone streams (AG = arctic grayling, ChS = chum salmon, CS = coho salmon, CT = cutthroat trout, DV = Dolly Varden, PS = pink salmon, RT = rainbow trout, SS = sockeye salmon)

Location	Number anglers	Days fished	AG	ChS	CS	CT	DV	PS	RT	SS
Kenai Peninsula Zone										
Russian River	22,615	44,533			2,624		4,426	1,213	10,481	63,589
Resurrection Creek	2,603	2,927		529	197		79	11,073		581
Sixmile Creek	*Responses not reported, 12 or fewer responses received*									
Quartz Creek	1,164	2,475			16		5,807		1,425	343
Crescent Lake	925	935	743						0	
Kenai Lake	*Responses not reported, 12 or fewer responses received*									
Twentymile River	721	1,045		161	521		106			
Prince William Sound Zone										
Alaganik Slough	1,157	3,623			3,355		56			
Eyak River	1,597	5,310			2,748		521	26		1,514
Ibeck Creek	1,313	3,467			3,773	287	167			195

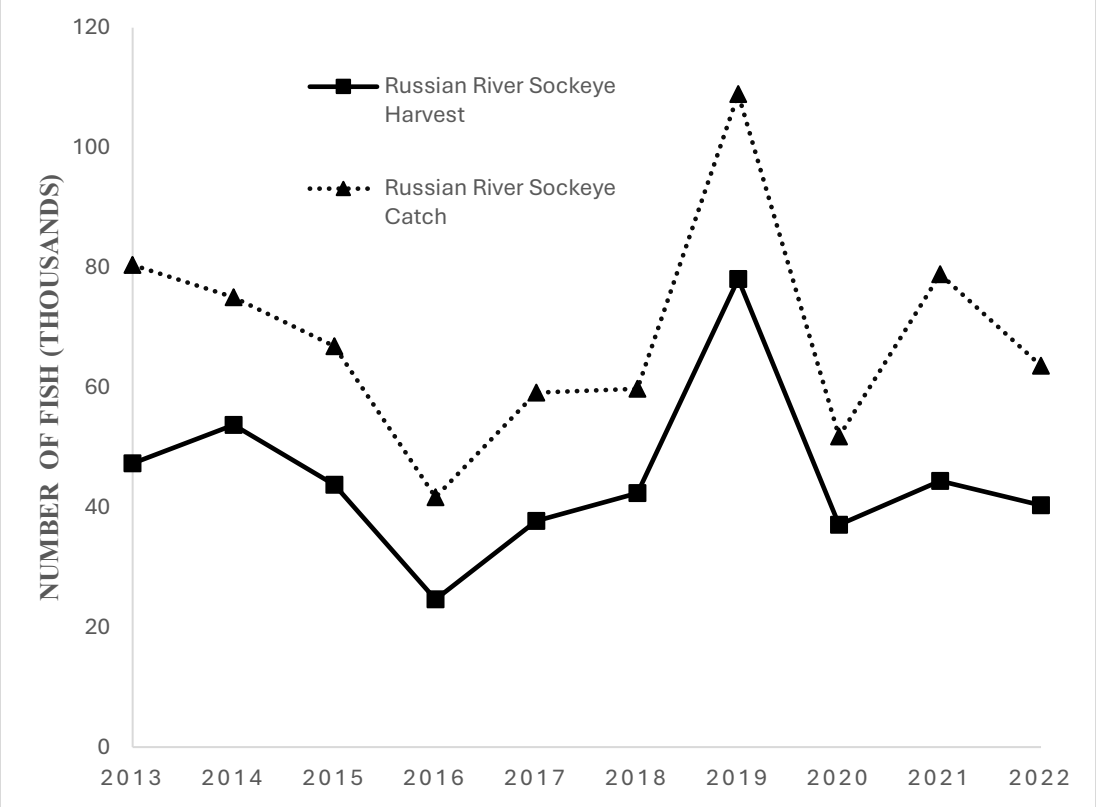

Figure 21. Kenai Peninsula Zone Russian River sockeye salmon harvest and catch 2013-2022. Harvest and catch are solid and dotted lines, respectively.

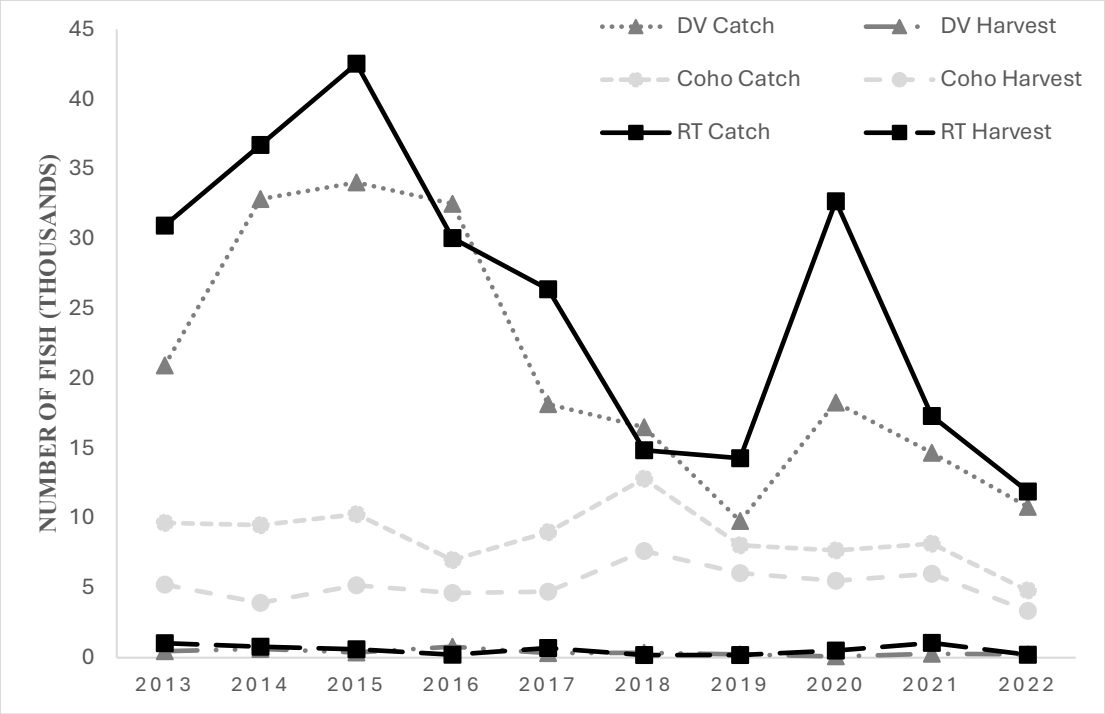

Figure 22. Kenai Peninsula Zone Dolly Varden, coho salmon, and rainbow trout harvest and catch 2013-2022. Harvest, catch, and species are differentiated by grey shade and line type (solid, dotted, and dashed).

Prince William Sound Zone

The 2022 harvest and catch from the three Prince William Sound Zone monitoring streams were below average for coho salmon, Dolly Varden, and pink salmon, above average for sockeye salmon, and below average for cutthroat trout harvest, but near average for cutthroat trout catch (Table 22). Coho salmon harvest and catch is on a declining trend and the lowest recorded values in the preceding 10-year history occurred in 2022 (Figure 22 and Figure 23) In 2022, Alaganik Slough, Eyak River, and Ibeck Creek all experienced comparable levels of coho harvest, although catches were higher in Alaganik and Ibeck than Eyak River. Conversely, in 2022, sockeye salmon harvest and catch were the highest recorded for the preceding 10-year period (Figure 24). In the Prince William Sound Zone, sockeye salmon harvest and catch predominantly occur on the Eyak River.

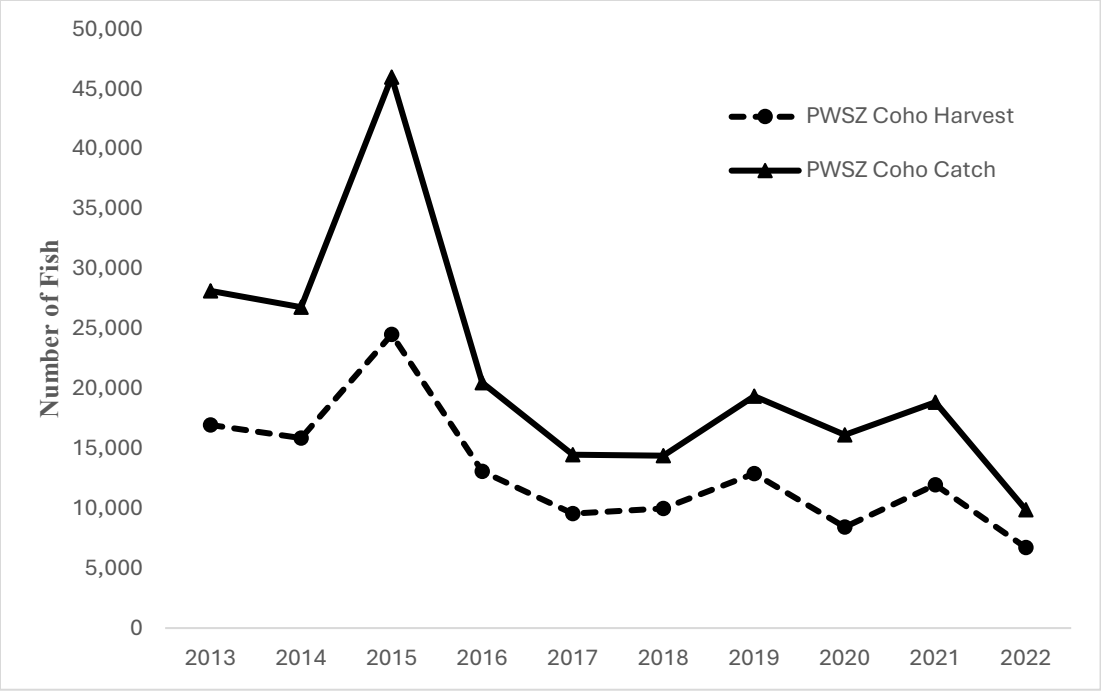

Figure 23. Prince William Sound Zone coho salmon harvest and catch 2013-2022. Harvest and catch are represented by solid and dashed lines, respectively.

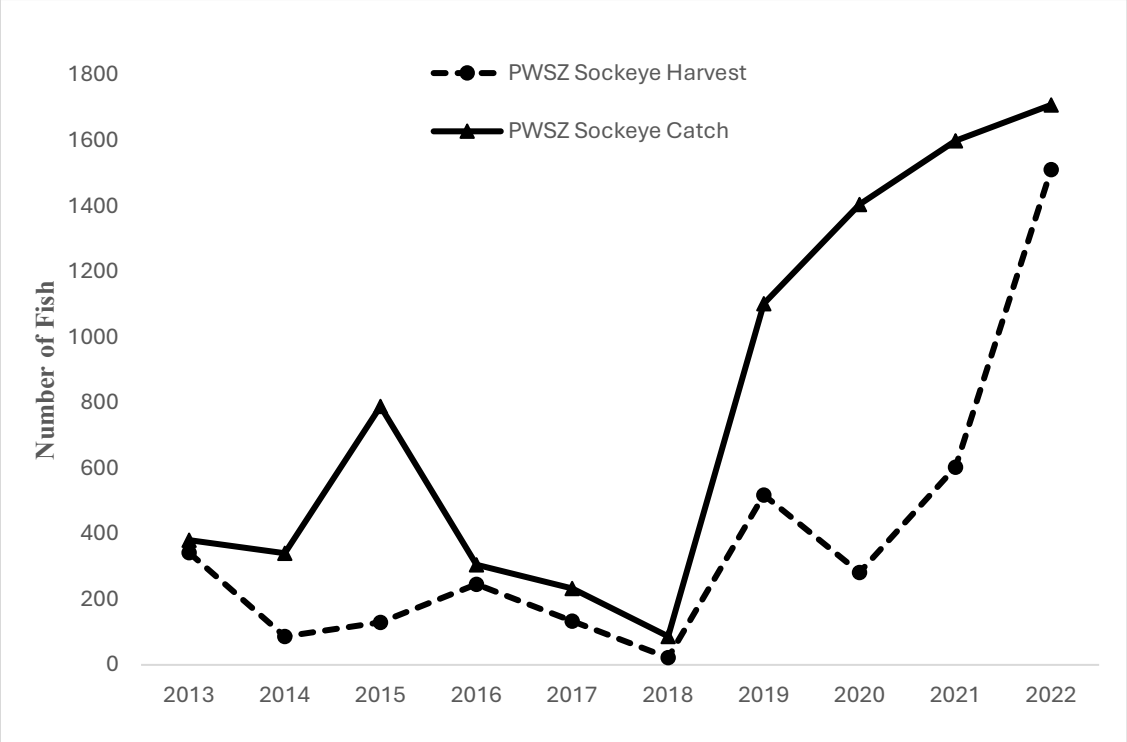

Figure 24. Prince William Sound Zone sockeye salmon harvest and catch 2013-2022. Harvest and catch are represented by dashed and solid lines, respectively.

Recommendations

No changes are recommended for sport fisheries at this time.

Indicator 7.5. Trends in number of permits issued for subsistence harvest

Key Results

Overall, wildlife and fish harvest opportunity under the federal subsistence program has remained relatively stable over the past two years (2022-2023) (Figure 25 and Figure 26, Table 23 and Table 24). These numbers generally vary according to demand, however the draw permits for Moose in Unit 6C of the Copper River Delta and Mountain Goats and Dall Sheep in Unit 7 of the Kenai Peninsula reflect the harvestable number of animals (based on population estimates) and the Federal/State harvest allocation (determined by regulation or negotiated with the State). A notable increase in the number of fish permits issued in the Kenai Zone is related to the customary and traditional use determination that Moose Pass received for Federal fisheries in the Kenai and Russian River fisheries.

Harvest has also remained relatively stable overall, although it varies due to several factors such as effort, weather, population size/run strength, and other factors. A substantial increase in fish harvest was observed in the Kenai Zone concurrent with the increase in fish permits. There was also a substantial increase in the harvest of Moose in the Kenai Zone despite a slight decrease in the number of permits issued. In general, wildlife and fish populations have supported subsistence harvest for rural residents of the Chugach National Forest.

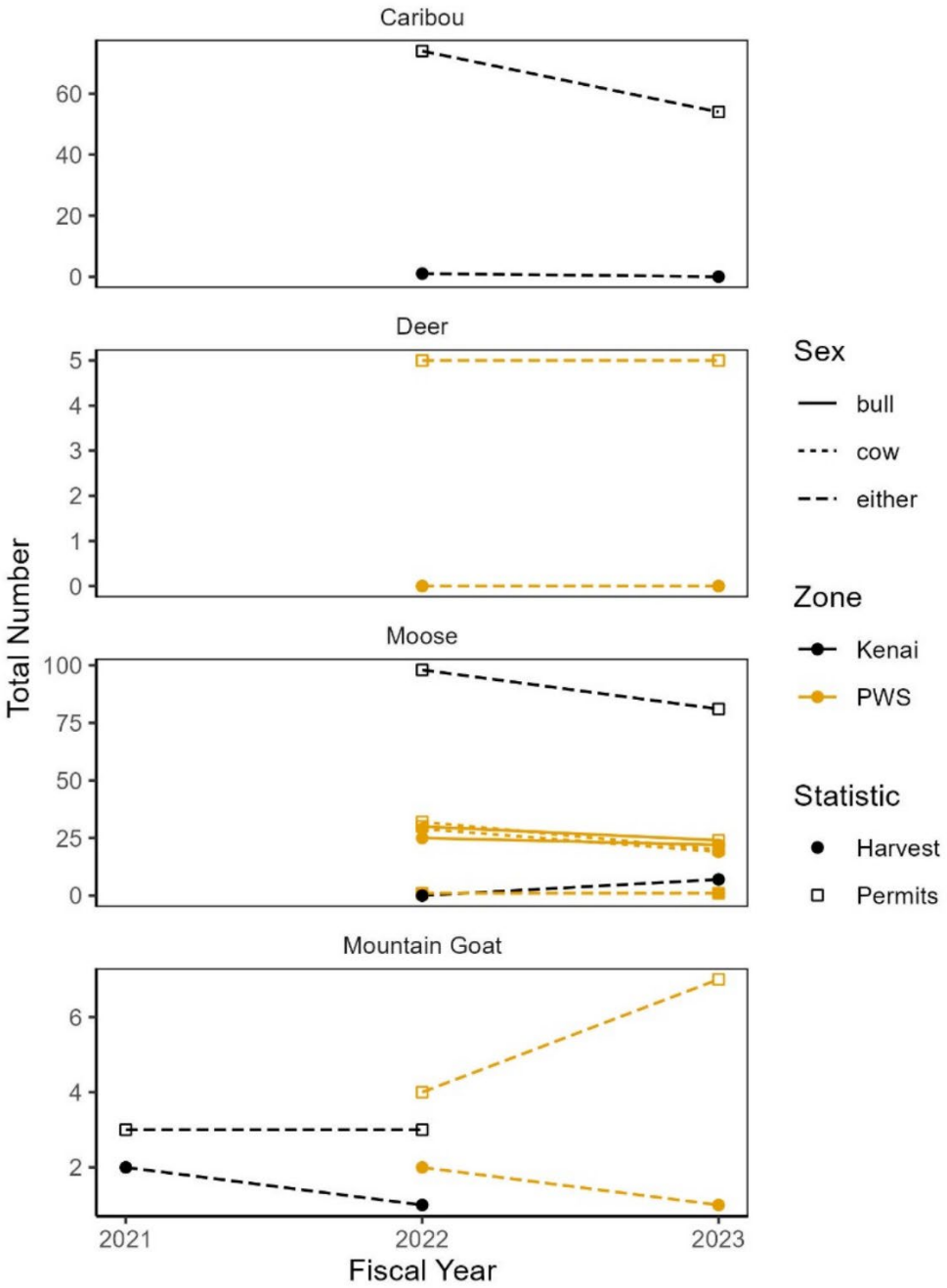

Figure 25. Subsistence ungulate permits issued and harvest in Chugach National Forest, 2021-2023. Sex, zone, and statistic (harvest or permits) are differentiated by line type, color, and point type, respectively.

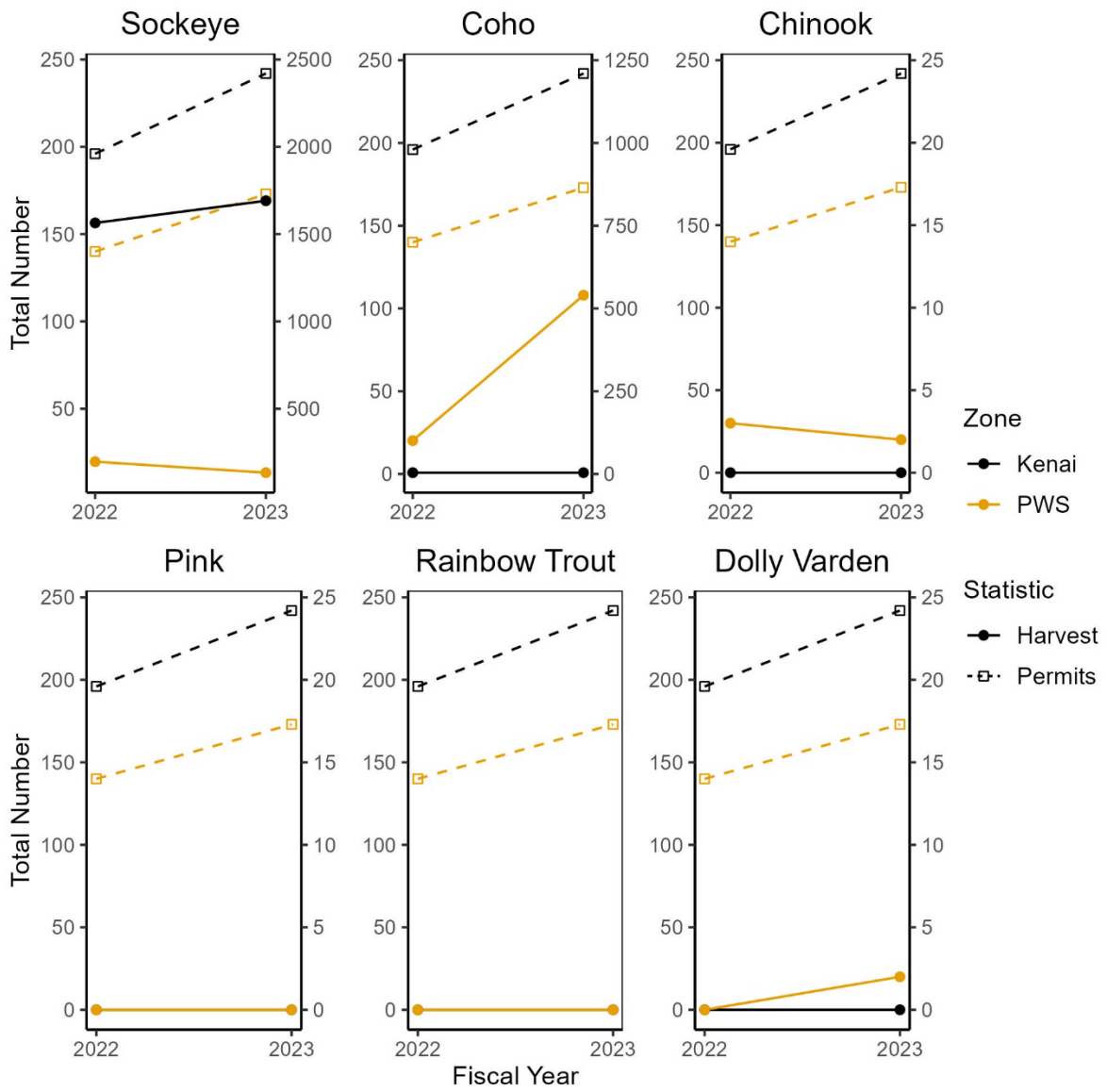

Figure 26. Subsistence fish permits issued and harvest in Chugach National Forest, 2021-2023. Zone and statistic (harvest or permits) are differentiated by line type, color, and point type, respectively.

Table 23. Hunt-specific permits issued and animals harvested through federal subsistence harvest seasons (events) within the Chugach National Forest.

Zone	Unit	Event	Species	Year	Permits	Harvest
PWS[a]	6C	FM0601	Moose - bull	2022	30	25
PWS	6C	FM0601	Moose - bull	2023	24	22
PWS	6C	FM0603	Moose - cow	2022	32	29
PWS	6C	FM0603	Moose - cow	2023	20	19
PWS	6B, 6C	FM0607	Moose	2022	1	1

Zone	Unit	Event	Species	Year	Permits	Harvest
PWS	6B, 6C	FM0607	Moose	2023	1	1
PWS	6	FD0605	Deer	2022	5	0
PWS	6	FD0605	Deer	2023	5	0
PWS	6	FD0606	Deer	2022	5	0
PWS	6	FD0606	Deer	2023	5	0
PWS	6D	FG0604	Mountain Goat	2022	4	2
PWS	6D	FG0604	Mountain Goat	2023	7	1
Kenai	7 remainder	FM0004	Moose	2022	98	0
Kenai	7 remainder	FM0004	Moose	2023	81	7
Kenai	7	FC0702	Caribou	2022	74	1
Kenai	7	FC0702	Caribou	2023	54	0
Kenai	7	DG0703	Mountain Goat	2022	3	1
Kenai	7	DG0703	Mountain Goat	2021	3	2

a – PWS=Prince William Sound

Table 24. Fishery-specific permits issued and fish harvested through federal subsistence harvest seasons (events) within the Chugach National Forest

Zone	Event	Species	Year	Permits	Chinook	Coho	DV[b]	Pink	Rainbow Trout	Sockeye
PWS[a]	FFPW01	Fish	2022	81	0	101	0	0	0	84
PWS	FFPW01	Fish	2023	112	0	439	2	0	0	43
PWS	FFPW05	Fish	2022	70	3	0	0	0	0	113
PWS	FFPW05	Fish	2023	72	1	0	0	0	0	61
Kenai	KKTCI2	Fish	2022	73	0	4	0	0	0	73
Kenai	KKTCI2	Fish	2023	101	0	3	0	0	0	115
Kenai	KKTCI3	Fish	2022	336	0	43	0	1	5	5434
Kenai	KKTCI3	Fish	2023	365	0	1	0	0	0	6200

a – PWS=Prince William Sound; b – DV = Dolly Varden

Recommendations

We have no recommended changes to the forest plan components or management activities currently. Harvest opportunity (permits) has remained stable for federal subsistence users of the Chugach National Forest. The number of permits issued generally reflects demand. However, in the case of Unit 6C moose and Unit 7 mountain goats, permit numbers reflect the number of animals that can be sustainably harvested based on population estimates. The Chugach subsistence program will continue to partner

with the State of Alaska and the Chugach Regional Resources Commission to obtain current population data to ensure sustainable harvest of these species, which may result in changes to recommendations of permissible harvest levels.

Indicator 7.6. Trends in number of mineral materials permits issued and locatable mineral plans of operation approved.

Key Results

Demand for mineral materials contracts remained steady across FY22-FY23 relative to previous years (Figure 27). The number of locatable mining plans of operations continued to decline, from 9 in 2020 to 4 in 2023.

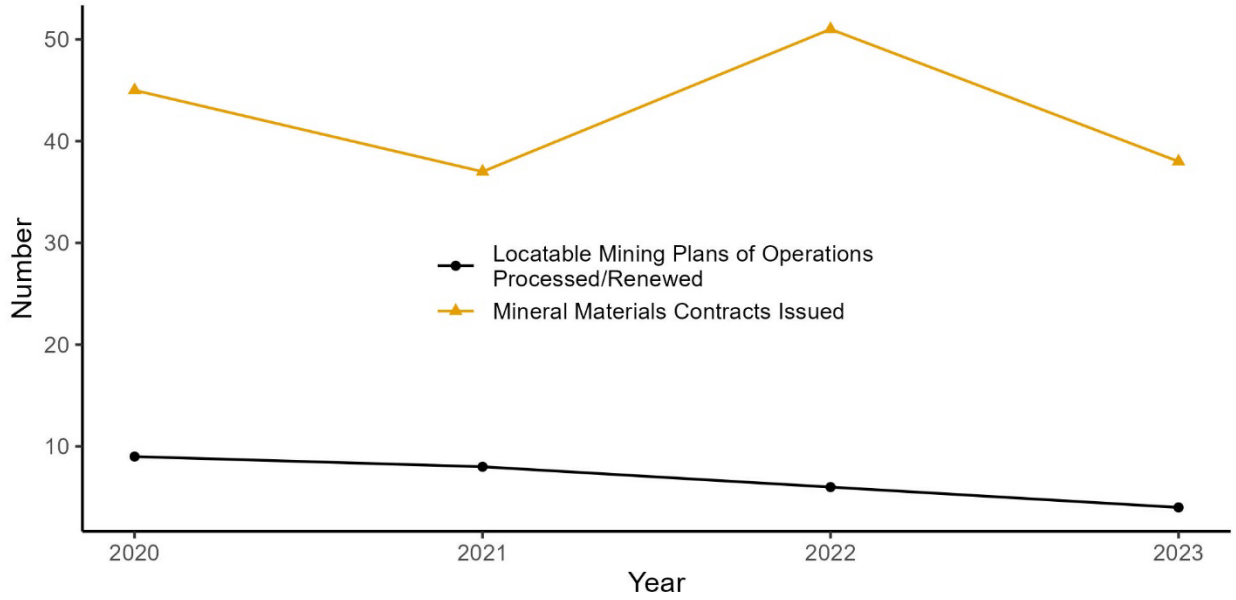

Figure 27. Trends in number of mineral materials permits issued FY 2020-2023. Plans and contracts are orange and black, respectively.

Recommendations

No changes to Forest Plan language are recommended.

Monitoring Question 8. Is the presently existing character of the wilderness study area being maintained?

Indicator 8.1. Wildness

Key Results

Data for the 'wildness' measure is gathered and evaluated annually. In 2022-2023, there were 12 activities authorized that intentionally manipulated the biophysical environment (Table 25). This is a reduction of 2 from the 2020-2021 monitoring period. Most of these activities have been occurring for many years.

Table 25. Record of authorized manipulations in 2022-23

Action(s)	Purpose	Year activity was first authorized
Using a weir to temporarily block salmon from upper Coghill River/Lake	Fish counts	1972
Using a weir to capture/kill salmon on Coghill River for sampling	Study hatchery escapement	1972
Enclosing, capturing, killing salmon at Cannery Creek Hatchery	Produce hatchery salmon	1982
Maintain a dam at Cannery Creek to alter water flow and store water	Create water source for hatchery	1982
Use a pipe to divert water from Main Lake	Create water source for hatchery	1978
Enclosing, capturing, killing salmon at Main Bay Hatchery	Produce hatchery salmon	1978
Maintaining a dam and fish ladders at Solf Lake	Alter level of Solf Lake to change lake outflow, enabling salmon to access the lake. Use ladders to assist fish access to lake	1997
Maintain a fish structure at Pigot Bay creek	Enhance salmon habitat and reproduction	Early 1990's
Maintain a fish structure at Shrode Lake outflow to alter hydrology	Enhance salmon habitat and reproduction	Early 1990's
Maintain a fish ladder at Otter Creek, Knight Island to increase fish access to stream	Increase fish reproduction	Early 1990's
Maintain a fish ladder at Derickson to increase fish access to stream	Increase fish reproduction	Early 1990's
Maintain a fish ladder at Red Creek, Esther Passage, to increase fish access to stream	Increase fish reproduction	Increase fish reproduction

Recommendations

Based on these results, there is no need for any changes.

Indicator 8.2. Natural conditions

Key Results

Weight of marine debris collected at key monitoring sites

The value for this measure is reported in "total weight", however, there are various data points that should be observed when evaluating trends in marine debris. Gulf of Alaska Keeper's data highlight trends that can be tied back to specific events such as the 2011 Tohoku Japan earthquake or certain container ship accidents (Table 26). Examples of this include a statistically significant (R^2 >0.2) 2011-2021

increase in Styrofoam and Japanese fishing gear. Other notable trends include a statistically significant increase in drinking bottles, floats, and a decrease in non-beverage bottles.

Table 26. Marine debris collected by Gulf of Alaska Keeper in the wilderness study area

Monitoring cycle	Value (total weight in lbs.)
2007-2011	2388.6
2012-2016	2564.6
2017-2021	3195.6

Number of miles of streams listed as "impaired" on the State of Alaska Department of Environmental Conservation 303D database

There are currently 110 watersheds either entirely within or partially within the wilderness study area boundary. Of these, none are currently listed as "impaired" on the 303D list by the State of Alaska Department of Environmental Conservation. This database was last updated in 2020. However, 0.5 miles of stream located in the northwest portion of the Port Wells – Frontal Guld of Alaska watershed (HUC 1902020121) near the Granite Mine has shown water quality exceedances. This data is captured within the Watershed condition classification water quality attribute ratings and is shown to be "functioning at risk" for 0.5 miles of stream.

Trends in the Forest Service watershed condition class rating for wilderness study area watersheds.

For the third measure, trends in the Forest Service watershed condition class rating for the wilderness study area watersheds continue to reflect functioning status. Forest-wide results for watershed condition class can be found in Section 1, Watershed conditions: Key Results for Watershed Condition Classification ratings. Of the 110 watersheds either entirely within or partially within the wilderness study area boundary, all are classified as 'functioning properly'. Several indicators are measured to establish this score. While certain indicators may be considered at risk, they don't weigh enough to impact the entire watershed score. As part of the National Five-year Watershed Condition Classification re-assessment watersheds with anticipated changed conditions were re-assessed across the forest. Only one watershed, the Port Wells – Frontal Prince William Sound (HUC 1902020121), was re-assessed for changed conditions. This watershed was re-assessed for changed conditions for the water quality attribute (water quality problems - not ADEC listed) due to the presence of abandoned metals in the northwest portion of the watershed. An internal report in 2017, as part of the Environmental Evaluation/Cost Analysis by Hart Crowser, documented soil and water quality exceedance levels near the Granite Creek mine related to heavy metal concentrations. However, based on the small percentage of the watershed with impairment the attribute indicator did not change and remained in a class 2 – functioning at risk condition.

Recommendations

Based on these results, there are no recommended changes for the marine debris collected. There are no standards or guidelines in the forest plan that would change this trend because marine debris is generated in the marine environment and is not within Forest Service jurisdiction to manage. The Chugach National Forest currently works with Gulf of Alaska Keeper, Prince William Sound Stewardship Foundation, and others to remove debris annually from select locations and track trends.

We also have no recommended changes to plan components, management activities or the monitoring plan for miles of stream impaired and watershed conditions. Future considerations are for us to reevaluate the insects and disease attribute to include the "anticipated" mortality to see if there is a substantial change using the national insect and disease risk and hazard mapping data. This will ensure that our future long-term trends are accurate.

Indicator 8.3. Undeveloped

Key Results

Authorized use of motorized equipment and mechanical transport

The annual number of authorizations decreased during this monitoring period (Figure 28). When reviewing the data from 2022 to 2023, the change within motorized uses is largely attributed to the completion of the Goose Bay cabin construction along with fewer helicopter visits to Barry Arm.

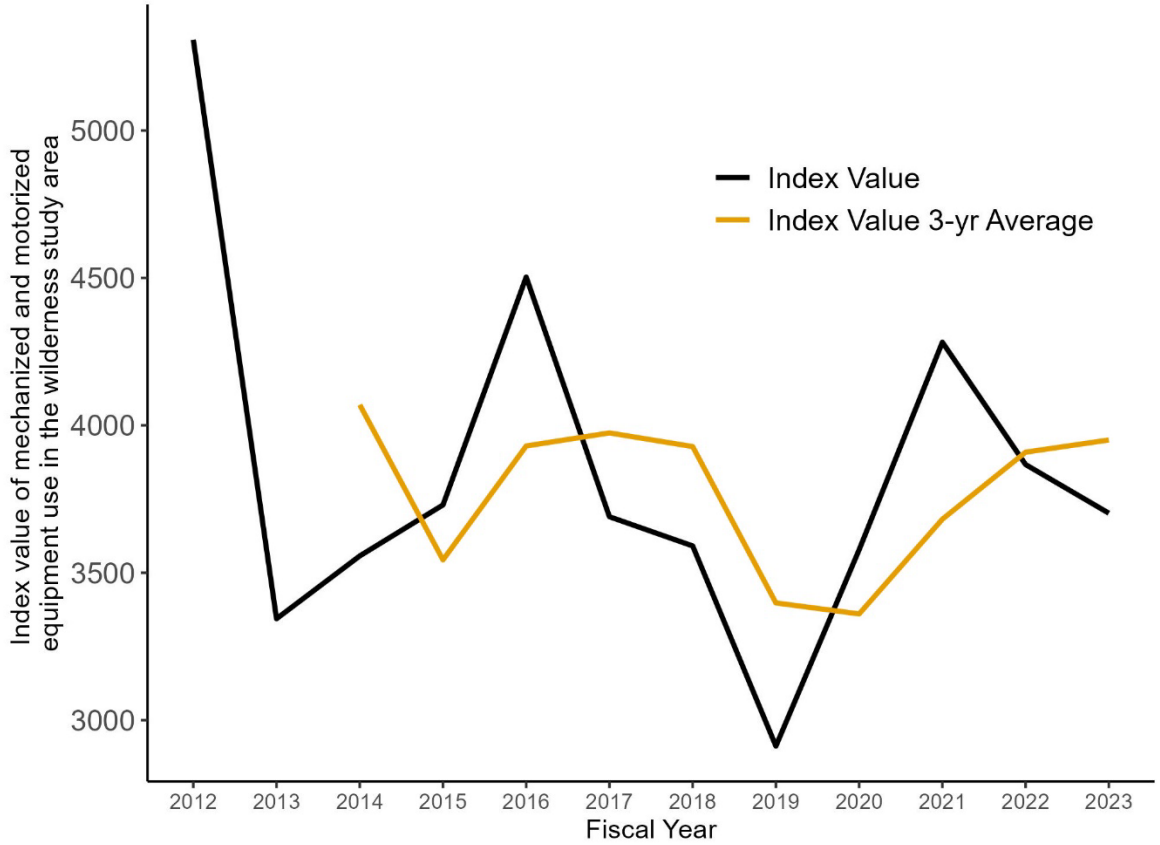

Figure 28. Index of authorized use of motorized equipment and mechanical transport in the wilderness study area (2020-2023). Value and 3-yr average value are displayed as black and orange, respectively.

Authorized number of installations and developments

Monitoring shows that numbers of authorized installations and developments increased during FY2022-2023 (Figure 29). Since 2020, the number of sites with developments increased by 6 percent, while the overall number of development features increased by 14.6 percent. The increases are primarily due to research.

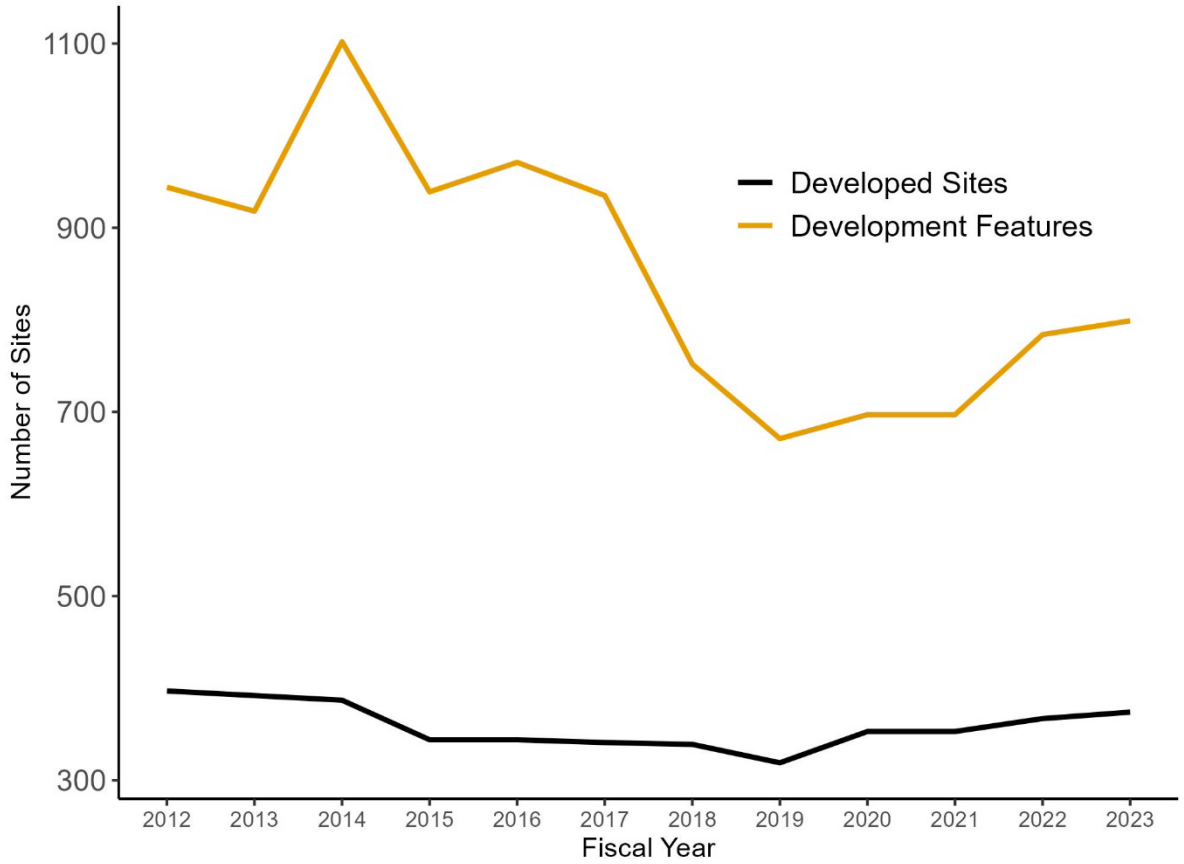

Figure 29. Total number of structures and installations within the wilderness study area 2020 through 2023. Sites and features are displayed as black and orange, respectively.

Recommendations

Currently, changes to the forest plan are not needed. We will continue monitoring trends in authorizations for motorized equipment and installations/development. We will continue analyzing the impact of projects such as monitoring in Barry Arm to identify when unique circumstances cause changes.

Indicator 8.4. Outstanding opportunities for solitude or primitive, unconfined types of recreation

Key Results

The data show that over 50% of sites visited in 2022 and 2023 show very little sign of human use (Figure 30). These two years of data are not comparative since each year targets a different monitoring zone.

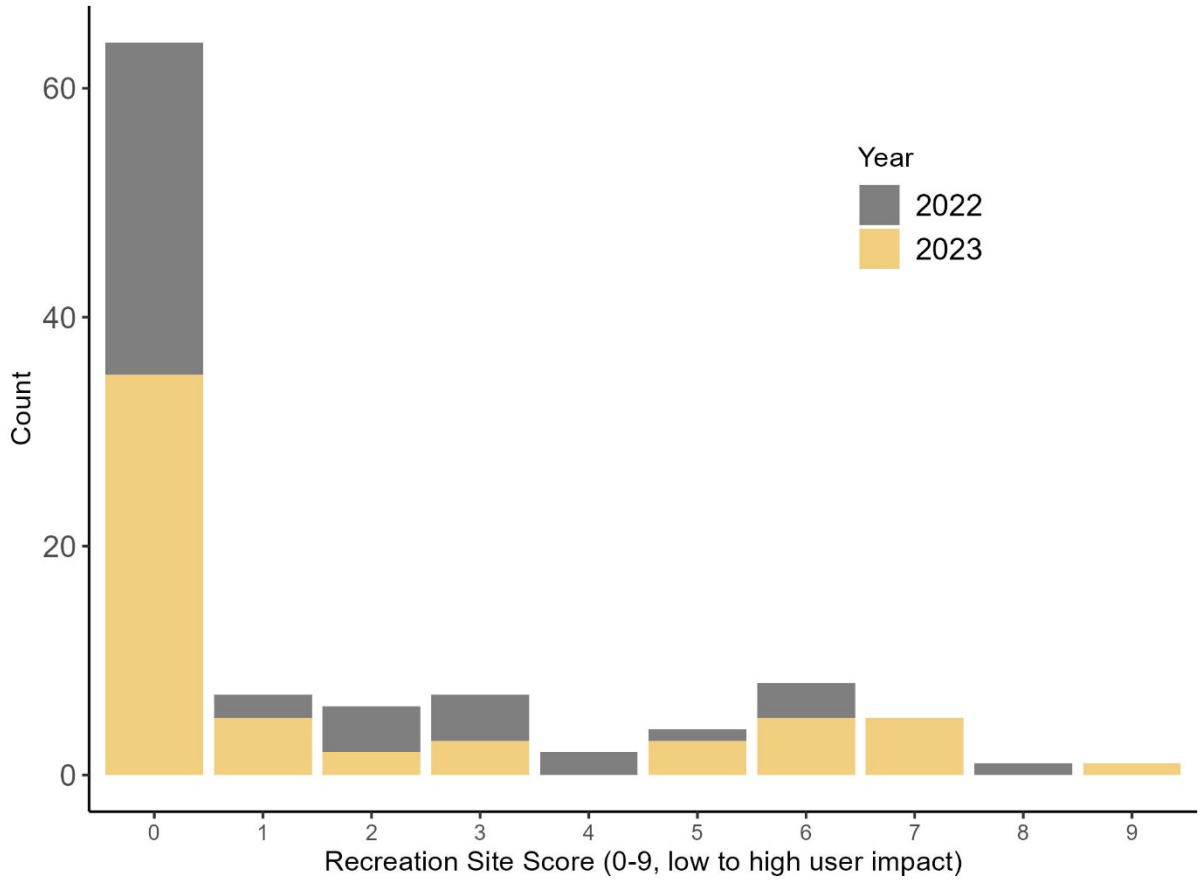

Figure 30. The overall score for rec sites visited during the 2022 (grey) and 2023 (orange) field season. This does not represent trends. It highlights the ongoing findings that over 50% of sites show little sign of human use. This is a 2-year snapshot, which is part of a broader 5-year monitoring cycle.

Recommendations

Based on the discovery of a large slope instability in Barry Arm, which compromises staff safely working in the area, we will adjust the encounters monitoring protocol in 2024. Staff will not be conducting campsite monitoring for an undetermined time in Barry Arm or Harriman Fiord.

Table 27. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps.

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 7 MI 7.1	See Section 5, Indicator 5.2	
MQ 7 MI 7.2	See Section 5, Indicator 5.1	

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 7 MI 7.3	Forest product permits have remained within the expected ranges over the last 8 years. The number of commercial special forest products permits has remained steady, except for 2020, where the number of commercial permits for mushroom harvesting increased dramatically following the 2019 Swan Lake	We are not recommending any changes
MQ 7 MI 7.4	There are no current published data to report for this report period.	We have no recommended changes to the forest plan components or management activities.
MQ 7 MI 7.5	Overall, wildlife and fish harvest opportunity under the federal subsistence program has remained relatively stable over the past two years.	We have no recommended changes to the forest plan components or management activities.
MQ 7 MI 7.6	Demand for mineral materials contracts was remained steady across FY22-FY23 relative to previous years, whereas the number of locatable mining plans of operations continued to decline, from 9 in 2020 to 4 in 2023.	We have no recommended changes to the forest plan components or management activities.
MQ 8 MI 8.1	In 2022-2023, there were 12 activities authorized that intentionally manipulated the biophysical environment. This is a reduction of 2 from the 2020-2021 monitoring period.	Based on these results, there is no need for any changes.
MQ 8 MI 8.2	We observed a 2011-2021 increase in Styrofoam and Japanese fishing gear. Other notable trends include a statistically significant increase in drinking bottles, floats, and a decrease in non-beverage bottles.	There are no recommended changes.

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
	Of these, no watersheds in CNF are currently listed as "impaired" on the 303D list by the State of Alaska Department of Environmental Conservation. However, there is 0.5 miles of stream located in the northwest portion of the Port Wells – Frontal Guld of Alaska watershed (HUC 1902020121) near the Granite Mine that has shown water quality exceedances. Trends in the Forest Service watershed condition class rating for the wilderness study area watersheds continue to reflect functioning status	
MQ 8 MI 8.3	Authorized use of motorized equipment and mechanical transport decreased, whereas numbers of authorized installations and developments increased throughout 2022-2023.	Currently, changes to the forest plan are not needed.
MQ 8 MI 8.4	Over 50% of sites visited in 2022 and 2023 show very little sign of human use	Based on the discovery of a large slope instability in Barry Arm, which compromises staff safely working in the area, we will adjust the encounters monitoring protocol in 2024. For an undetermined time, staff will not be conducting campsite monitoring in Barry Arm and Harriman Fiord

Effects of Management Activities on the Productivity of the Land

Regional soil quality standards, along with national and regional best management practices and forest plan standards and guidelines, are utilized to minimize impacts to soil and water quality from ground disturbing activities and maintain productivity of the land. Region 10 soil quality standards stipulate that no more than 15 percent of an activity area in the productive land base should have detrimental soil conditions to preserve long-term soil productivity. Due to the large amount of Spruce beetle killed trees, burn piles are being utilized to dispose of woody debris. Burning slash piles has the potential to cause significant impacts to underlying soil due to high temperatures. Monitoring is currently needed to determine the areal extent and impact of burn piles on soil productivity, and the implementation and effectiveness of soil quality standards, best management practices, and forest plan standards and guidelines.

Monitoring Question 9. Are management activities meeting and maintaining soil productivity, state water quality standards, and land management plan desired conditions, goals, and objectives?

Indicator 9.1. Soil disturbance resulting from management activity

Key Results

- In 2022, soil quality monitoring was conducted on one timber sale unit where ground-based harvesting with scarification was implemented. Based on field transects and aerial imagery interpretation after harvesting, it is estimated that about 8% of the unit has detrimental soil conditions. This is within Region 10 Soil Quality Standards (USDA Forest Service, 2023), which require maintaining soil productivity on a minimum of 85% of an activity area. Detrimental soil disturbance was caused by temporary roads (2.4%), skid trails (2.4%), and slash piles that will be burned (3.1%). Burn piles had an average diameter of 9 m.
- Twenty burn pile locations in Quartz Creek Campground were examined in 2022 to determine effects of pile burning on soils, and 36 piles were photographed to monitor revegetation. The burn piles ranged in size from 2-6 m diameter. Soils in the Quartz Creek Campground resemble the mapped soil series (Bernice soil series: Sandy-skeletal, mixed Typic Haplocryod). Twelve of the twenty burn pile locations had no O-horizon and another 4 piles only had a thin 1 cm O-horizon remaining after burning, indicating much of the nutrient storage capacity and water holding capacity of those soils was lost. The O-horizon thickness in unburned areas adjacent to burn piles ranged from 0-11 cm thick, with a mean of 6 cm. Additional monitoring is needed to determine effects to revegetation at the burn pile locations. Areas that are not dedicated to productivity such as campgrounds are excluded from the soil quality standards, but best management practices still apply and this monitoring will provide information on BMP effectiveness and burning effects to soils.

Recommendations

No changes are recommended currently. More monitoring is needed to determine the effectiveness of existing BMPs, standards and guidelines.

Table 28. Recommendations, progress toward land management plan desired conditions and objectives, and recommended actions/next steps

Monitoring question (MQ) and Monitoring indicator (MI)	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 9 MI 9.1	Soil quality monitoring was conducted on one timber sale unit and at twenty burn pile locations. 8% of the unit has detrimental soil conditions. This is within Region 10 Soil Quality Standards.	No changes are recommended.

Summary of Results and Recommendations

Chugach National Forest monitoring questions and indicators addressed in this report. Possible types of recommendations include changes to the land management plan or monitoring plan, changes in management activities, or recommendations for a new focused assessment.

Table 29. Monitoring questions, results, and recommendations.

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 1. Are management actions effective in maintaining or improving watershed integrity?	MI 1.1. National best management practices ratings	Management actions are maintaining or improving watershed integrity.	BMP effectiveness could be improved through better project planning to identify applicable BMPs and regular inspection and enforcement of BMP application
	MI 1.2. Watershed Condition Classification Ratings	The next reassessment will be in fiscal year 2026, so there is no new information to include or analyze in this report.	No recommendations will be issued until the next analysis in 2026.
MQ 2. Are management strategies effectively controlling or preventing the spread of invasive species in aquatic and terrestrial systems?	MI 2.1. Trend in the distribution and abundance of four highly invasive terrestrial plants.	New infestations continue to occur in all four terrestrial species.	Continue to survey established monitoring polygons to establish trends in terrestrial focal species. Implement new strategy for monitoring highways to increase field staff safety.
	MQ 2.2. Trend in geographic range and number of waterbodies infested with *Elodea* spp.	One new infestation of *Elodea* in Crescent Lake was identified on the Seward Ranger District.	Continue to survey lakes identified at high risk for the introduction of *Elodea*.

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 3. Are management activities maintaining or improving aquatic habitat connectivity?	MI 3.1. Percentage of human-associated aquatic organism passage barriers improved or restored	Crossings were identified. High priority crossings were identified for construction.	We have no recommended changes to the forest plan components or management activities.
MQ 4. Are habitat conditions necessary to support populations of dusky Canada geese and Aleutian cress being maintained?	MI 4.1, 4.2, 4.3. Dusky Canada Goose population trends, nest success, nest predation	Following below average nest island occupancy and nest success in 2021, observed increases in productivity metrics during 2022 and 2023 may positively influence trends in total abundance soon.	We recommend that additional effort is focused on investigating ways in which the nest island program can become more productive.
	MI 4.4. Trend of known populations of Aleutian cress	The known distribution of Aleutian Cress on the Chugach National Forest has expanded due to new populations being discovered during the monitoring period.	• Increase the focus of targeted survey efforts to better understand the distribution of Aleutian cress on the Chugach National Forest. • Establish monitoring plots in Crow Pass and Summit Creek to monitor Aleutian Cress population trends on a broader scale.
	MI 4.5. Tree and shrub encroachment in alpine habitat	See Chapter 6, Indicator 6.2.	See Chapter 6, Indicator 6.4.
	MI 4.6. Persistence of alpine snowpack		

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
MQ 5. Are recreation opportunities and infrastructure achieving desired conditions, and are they sustainable?	MI 5.1. Recreation facility occupancy rate	Recreation facilities continue to show steady occupancy	We have no recommended changes to the forest plan components or management activities.
	MI 5.2. Number of outfitter guide permits issued and administered	We saw a slight increase in the number of outfitter and guides operating between 2022 and 2023. In addition, the last few permit Holders who had went into "Non-Use" during the 2020 pandemic moved back into "issued" status and were operating.	We recommend accepting outfitter and guide proposals, on a walk-in basis, for specific activities and locations within eastern Prince William Sound and Copper River. We recommend adding opportunities for new uses in the Spencer and Grandview Whistle stop areas. We recommend determining the appropriate areas and use capacities for small cruise operators in Prince William Sound as a priority planning project in 2024.
	MI 5.3. Number of miles of trail maintained by volunteers and partners	Trail miles maintained by partners has steadily increased post-pandemic.	We have no recommended changes to the forest plan components or management activities.
	MI 5.4. Number of recreation sites operated and maintained by volunteers and partners	The number has remained steady at 13.	We have no recommended changes to the forest plan components or management activities.

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
	MI 5.5. Total deferred maintenance forestwide	The trend data for deferred maintenance has continued to rise since our last biennial monitoring report, both in trails and our developed recreation sites.	Sustainability of our recreation facilities will be realized when timely maintenance reduces how much deferred maintenance is added to the total deferred maintenance each year and existing deferred maintenance is removed by reconstruction of aging facilities.
MQ 6. Is climate change affecting key ecological functions of terrestrial and aquatic habitats within the national forest?	MI 6.1. Changes in hydrographs on selected sites	This is the first year that streamflow data have been compiled and summarized for inclusion in the biennial monitoring report (Tables 13 and 14).	We have no recommended changes to the forest plan components or management activities.
	MI 6.2. Tree and shrub encroachment in alpine habitat and recently deglaciated areas	Changes in vegetation and snow cover were seen along anticipated trajectories for the districts, as well as forest-wide, however, those changes were all within the margin of error for the 35-year analysis period.	• Map data and imagery used to model change in the LCMS dashboard should be updated prior to the next analysis period. • Data from 1985 and 1986 should be excluded from future analysis due to sizable anomalies. • Change detection analyses should be done on predetermined key areas of the forest where change is likely occurring more rapidly
	MI 6.3. Changes in water temperature on selected sites	Stream temperature data for the water year 2020 to 2023 were compiled and summarized for inclusion in this biennial monitoring report (Tables 15 and 16).	We have no recommended changes to the forest plan components or management activities.

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
	MI 6.4. Snow depth, season of snow cover	SNOTEL data for the water years 2020 to 2023 were compiled and summarized inclusion in this biennial monitoring report (Table 18).	Further statistical analysis will be performed (e.g., ANOVA, t-tests, and simple linear regression) when sufficient data are available to detect temporal trends and make comparisons among streamflow types (i.e., glacier vs. snow-dominated).
MQ 7. Is the national forest providing a sustainable, predictable level of goods and services to communities?	MI 7.1. Trends in number of commercial recreation permits issued	See Section 5, Indicator 5.2	
	MI 7.2. Trends in developed recreational facility use	See Section 5, Indicator 5.1	
	MI 7.3. Trends in number of commercial recreation permits issued	Forest product permits have remained within the expected ranges over the last 8 years. The number of commercial special forest products permits has remained steady, except for 2020, where the number of commercial permits for mushroom harvesting increased dramatically following the 2019 Swan Lake	We have no recommended changes to the forest plan components or management activities.
	MI 7.4. Trends in sport fishing harvest	There are no current published data to report for this report period.	We have no recommended changes to the forest plan components or management activities.

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
	MI 7.5. Trends in number of permits issued for subsistence harvest	Overall, wildlife and fish harvest opportunity under the federal subsistence program has remained relatively stable over the past two years.	We have no recommended changes to the forest plan components or management activities.
	MI 7.6. Trends in number of mineral materials permits issued and locatable mineral plans of operation approved	Demand for mineral materials contracts was remained steady across FY22-FY23 relative to previous years, whereas the number of locatable mining plans of operations continued to decline, from 9 in 2020 to 4 in 2023.	We have no recommended changes to the forest plan components or management activities.
MQ 8. Is the presently existing character of the wilderness study area being maintained?	MI 8.1. Wildness	In 2022-2023, there were 12 activities authorized that intentionally manipulated the biophysical environment. This is a reduction of 2 from the 2020-2021 monitoring period.	We have no recommended changes to the forest plan components or management activities.

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
	MI 8.2. Natural conditions	We observed a 2011-2021 increase in Styrofoam and Japanese fishing gear. Other notable trends include a statistically significant increase in drinking bottles, floats, and a decrease in non-beverage bottles. No watersheds in CNF are currently listed as "impaired" on the 303D list by the State of Alaska Department of Environmental Conservation. However, there is 0.5 miles of stream located in the northwest portion of the Port Wells – Frontal Guld of Alaska watershed (HUC 1902020121) near the Granite Mine that has shown water quality exceedances. Trends in the Forest Service watershed condition class rating for the wilderness study area watersheds continue to reflect functioning status	We have no recommended changes to the forest plan components or management activities.

Monitoring Question (MQ)	Monitoring Indicator	Progress Toward Land Management Plan Desired Conditions and Objectives	Recommended Actions/Next Steps
	MI 8.3. Undeveloped	Authorized use of motorized equipment and mechanical transport decreased, whereas numbers of authorized installations and developments increased throughout 2022-2023.	We have no recommended changes to the forest plan components or management activities.
	MI 8.4. Outstanding opportunities for solitude or primitive, unconfined types of recreation	Over 50% of sites visited in 2022 and 2023 show very little sign of human use	Based on the discovery of a large slope instability in Barry Arm, which compromises staff safely working in the area, we will adjust the encounters monitoring protocol in 2024. For an undetermined time, staff will not be conducting campsite monitoring in Barry Arm and Harriman Fiord.
MQ 9. Are management activities meeting and maintaining soil productivity, state water quality standards, and land management plan desired conditions, goals, and objectives?	MI 9.1. Soil disturbance resulting from management activity	Soil quality monitoring was conducted on one timber sale unit and at twenty burn pile locations. 8% of the unit has detrimental soil conditions. This is within Region 10 soil quality standards.	We have no recommended changes to the forest plan components or management activities.

References

Hayward, Gregory Dale, Stephen Colt, Monica L McTeague, Teresa Nettleton Hollingsworth, and others. 2017. "Climate Change Vulnerability Assessment for the Chugach National Forest and the Kenai Peninsula." *General Technical Report-Pacific Northwest Research Station, USDA Forest Service* (PNW-GTR-950).