United States Department of Agriculture

Biennial Monitoring Evaluation Report

for the Bridger Teton National Forest

Forest Service Bridger Teton National Forest April 2019

For More Information Contact:

John Russell, Planning & Lands Staff Officer
Bridger-Teton National Forest
340 North Cache Street / P.O. Box 1888, Jackson, WY 83001
307-739-5500

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Summary of Findings and Results

In general, the monitoring results indicate that BTNF is meeting forest plan objectives (TABLE 1).

Monitoring from 2017-2018 revealed that there are two areas (of 56 total) where Forest Plan revision should be considered: air quality and forest vegetation. Current Forest Plan direction is considered outdated for these resources. There is only one area for which current monitoring results indicate that forest plan objectives may not be adequately met—trail maintenance—and ten areas where current status is uncertain due to inadequate data or methodology. There were six areas in which management activities may warrant change to better meet Forest plan objectives, namely recreation and access and vegetation (particularly fuels treatments). There are 16 indicators for which changes to the monitoring program are warranted, including changing indicators and methodologies.

Table 1. Quantitative summary of monitoring evaluation trends for all monitoring indicators (56 total)

	Yes	Uncertain	No
Forest Plan Objectives Met	45	10	1
Change to Forest Plan warranted	2	0	54
Change to management activities warranted	6	0	50
Change to monitoring program warranted	16	0	40
Focused assessment needed	4	0	52

Quantitative evaluation of indicators does not present a full picture of potentially critical issues that need addressing. A single indicator showing a downward or neutral trend may be enough to warrant management action or represent an opportunity for change. Conversely, the areas in which changes to the Forest Plan may be warranted are not necessarily considered to require urgent attention, as the associated stressors are long-term. The body of the report contains more details regarding specific management and monitoring recommendations as well as context to each recommendation.

Table 2. Summary of findings for all monitoring indicators

Monitoring Question	Indicator	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?
WTR-01: In what condition are the watersheds?	WTR-01: Multiple indicators from the Forest Service Watershed Condition Framework which includes both physical, biological, aquatic and terrestrial variables that affect watershed condition	Yes	No	N/A
AIR-01: Are air quality related values being impacted within wilderness areas and other areas of the Forest?	AIR-01-01: Lake water chemistry	Yes	No	N/A
	AIR-01-02: Critical Load Exceedances from nitrogen deposition	Yes	Yes	Forest plan
	AIR-01-03: Visibility	Yes	No	N/A
ARE-01: Are native aquatic and riparian ecosystems maintaining or improving in relation to aquatic invasive/exotic species?	ARE-01-01: Miles of stream and acres of lake habitats that have aquatic invasive/ exotic species present	Yes	No	N/A

Monitoring Question	Indicator	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?
	ARE-01-02: Miles of stream and acres of lake habitats in which aquatic invasive/ exotic species have displaced native aquatic species	Yes	No	N/A
VEG-01: To what extent is vegetation being impacted by management activities and natural disturbance processes?	VEG-01-01: Acres in each biophysical setting affected by vegetation management activities	Yes	Yes	Forest plan; management activities; monitoring program
	VEG-01-02: Acres affected by natural disturbance processes	Yes	Yes	Monitoring program
	VEG-01-03: Acres affected and/or susceptible to invasive plant species	Uncertain: methodology inadequate	Yes	Monitoring program
VEG-02: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of candidate whitebark pine?	VEG-02-01: Acres treated for the purpose of sustaining or restoring whitebark pine	Yes	No	N/A
	VEG-02-02: Acres by forest size class	Yes	No	N/A
WDL-01: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the endangered Kendall Warm Springs dace?	WDL-01-01: Population density estimates	Yes	No	N/A
	WDL-01-02: Number and type of habitat improvement projects since 1970	Yes	No	N/A
	WDL-01-03: Channel width to depth ratios (including vegetation encroachment) using 1995 research as baseline	Yes	No	N/A
	WDL-01-04: Channel Temperature and Water Quality/Chemistry using 1978 report as baseline	Yes	No	N/A
WDL-02: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the threatened Greater Yellowstone Area (GYA) grizzly bear?	WDL-02-01: Change from the 1998 baseline in secure habitat and motorized route density inside the PCA.	Yes	No	N/A
	WDL-02-02: Change from the 1998 baseline in developed sites inside the PCA.	Yes	No	N/A
	WDL-02-03: Change from the 1998 baseline in the number and acreage of commercial livestock grazing allotments and the number of sheep animal months inside the PCA.	Yes	No	N/A

Monitoring Question	Indicator	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?
	WDL-02-04: Change from the 2008 baseline in secure habitat outside the PCA.	Yes	No	N/A
WDL-03: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the threatened Canada lynx and its critical habitat?	WDL-03-01: Acres of Forest-wide fuel treatments and vegetation projects reported in accordance with the required monitoring found in the Northern Rockies Lynx Management Direction	Yes	No	N/A
	WDL-03-02: Changes in lynx habitat as a result of moving towards the desired conditions for vegetation through vegetation management, prescribed fire, or natural disturbance	Yes	Yes	N/A
WDL-04: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the threatened yellow-billed cuckoo?	WDL-04-01: Acres of cottonwood overstory riparian habitat	Yes	No	N/A
	WDL-04-02: Breeding Bird Survey (BBS) trend data for on-forest routes and incidental sightings.	Yes	No	N/A
WDL-05: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the proposed North American wolverine?	WDL-05-01a: Acres open to over-snow vehicle use; Miles of groomed over-snow trails (e.g. motorized and non-motorized) (duplicate of recreation indicator RA-03-02)	Yes	No	N/A
	WDL-05-02: Amount and seasonal variation of snowpack (duplicate of environmental stressors indicator EVS-01-02)	Yes	Yes	Monitoring program
FOC-01: Are forest management activities and/or natural events affecting aquatic conditions indicated by the status of a focal species?	FOC-01-01: Change in known distribution of native cutthroat species	Uncertain: more data needed	Yes	Monitoring program
	FOC-01-02: Change in relative abundance of native cutthroat species meta-populations as determined through monitoring surveys.	Uncertain: more data needed	No	Monitoring program
RA-01: Are developed recreation sites managed to standard?	RA-01-01: Condition of sites	Uncertain: methodology inadequate	Yes	Monitoring program
	RA-01-02: Change in extent of maintenance backlog	Uncertain: more data needed	No	N/A
	RA-01-03: Number of water systems that do not meet requirements	Yes	Yes	Monitoring program

Monitoring Question	Indicator	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?
RA-02: Are the amount and types of recreation opportunities provided meeting customer needs and expectations?	RA-02-01: Visitation estimates, visitor activities, and percent overall satisfaction (duplicate of econ indicator ECC-01-01)	Yes	No	N/A
	RA-02-02: Visitor numbers at ski areas, other resorts, and outfitter/guide services	Yes	Yes	Management activities; monitoring program
	RA-02-03: Annual percent occupied sites in campgrounds and picnic areas	Yes	Yes	Management activities; monitoring program
	RA-02-04: Acres providing various classes of recreation opportunity (ROS)	Yes	No	N/A
RA-03: Does the Forest road and trail system provide for motorized and non-motorized recreation opportunities in both summer and winter?	RA-03-01: Acres open to over-snow vehicle use (duplicate of wildlife indicator WDL-05-01a)	Yes	Yes	Management activities
	RA-03-02: Miles of groomed over-snow trails (e.g. motorized and non-motorized) (duplicate of wildlife indicator WDL-05-01b)	Yes	No	N/A
	RA-03-03: Miles of non-snow (summer) trails maintained for motorized and non-motorized use.	Yes	No	N/A
	RA-03-04: Trail miles maintained to standard	No	Yes	Management activities
	RA-03-05: Road miles maintained to standard	Yes	Yes	Monitoring program
WSR-01: Are the free-flowing conditions, water quality, and Outstandingly Remarkable Values for Wild and Scenic Rivers maintained and protected?	WSR-01-01: Watercraft use in Wild and Scenic Rivers	Uncertain: more data needed	No	N/A
	WSR-01-02: Occupancy of dispersed campsites in Wild and Scenic River corridors	Uncertain: methodology inadequate	Yes	Monitoring program
	WSR-01-03: Occupancy of vehicle access areas	Uncertain: more data needed	Yes	Monitoring program
WLDN-01: Do management activities in designated wilderness areas preserve wilderness character?	WLDN-01-01: Extent to which fire is playing its natural role	Yes	Yes	Monitoring program
	WLDN-01-02: Campsite condition and trail encounters	Yes	Yes	Management activities; monitoring program
	WLDN-01-03: Authorized motorized and mechanized entry	Yes	Yes	Monitoring program

Monitoring Question	Indicator	Do monitoring results demonstrate intended progress or trend toward Plan targets?	Based on the evaluation of monitoring results, may changes be warranted?	If a change may be warranted, where may the change be needed?
EVS-01: What stressors are impacting the plan area?	EVS-01-01: Extent of insect and disease infestation	Yes	No	N/A
	EVS-01-02: Amount of snowpack and spring runoff	Yes	Yes	Assessment
	EVS-01-03: Extent of invasive species	Yes	No	N/A
ECC-01: Are multiple use opportunities on the Forest contributing to the prosperity of local communities?	ECC-01-01: Forest visitor numbers (duplicate of rec indicator RA-02-01)	Yes	No	N/A
	ECC-01-02: Availability and use of commercial recreation opportunities	Yes	No	N/A
	ECC-01-03: Availability and use of livestock grazing opportunities	Yes	No	N/A
	ECC-01-04: Amount of timber offered and produced (duplicate of TIM-01-02)	Yes	Yes	Assessment
	ECC-01-05: Availability and use of firewood and other products for personal use	Uncertain: more data needed	Yes	Assessment
TIM-01: Is timber harvest occurring in a manner which does not impair the productivity of the land?	TIM-01: Implementation of Best Management Practices during timber harvest and transport	Uncertain: more data needed	No	N/A
	TIM-01-02: Amount of timber harvested relative to Allowable Sale Quantity as specified in the Forest Plan	Yes	Yes	Assessment
	TIM-01-03: Areas of regeneration harvest of timber re-stocked with young trees within five years of final harvest	Yes	No	N/A

Introduction

Purpose

Monitoring and evaluation are continuous learning tools that form the backbone of adaptive management of our national forests. The purpose of the biennial monitoring evaluation report is to help the responsible official determine how well forest plan objectives are being met on the Bridger Teton National Forest (BTNF) and whether changes are warranted in forest plan direction, management activities or the forest plan monitoring program based on new monitoring information or if additional focused assessment is needed. This report is a tool and a resource for the Forest Service to assess the condition of forest resources in relation to Forest Plan direction and management actions. It is also a tool and a resource for the public to learn more about how the Forest Service is managing forest resources. It is not a decision document.

The biennial monitoring evaluation report represents only one part of monitoring efforts on BTNF. It is targeted at evaluating the monitoring questions and indicators that were developed in 2016 to address new forest plan monitoring requirements under the 2012 planning rule. This is our first biennial evaluation report since a 2016 administrative change required forests to transition their monitoring programs to the direction provided in the 2012 planning rule. The 2012 planning rule monitoring requirements are available at: https://www.fs.usda.gov/detail/planningrule.

The Importance of Public Participation

BTNF is committed to adaptive management and recognized that the public plays an important role in keeping the monitoring plan relevant. The monitoring questions and indicators included in this report were developed with public participation in 2016. We informed the public of the availability of the 2018 biennial monitoring report for BTNF by posting full report on BTNF website at: https://www.fs.usda.gov/main/btnf/landmanagement/planning. Additionally, an email was sent to key stakeholders, including tribes and cooperating agencies.

We will consider all substantive comments received and welcome an open and engaged dialogue and participation.

About Our Forest Plan Monitoring Program

Responsible Official

Patricia O'Connor, Forest Supervisor, (307) 739-5500

Monitoring Plan Coordinator

John Russell, Planning and Lands Staff Officer, (307) 739-5560

How Our Plan Monitoring Program Works

Monitoring and evaluation requirements have been established through the National Forest Management Act (NFMA) at 36 CFR 219. Additional direction is provided by the Forest Service in Chapter 30 – Monitoring – of the Land Management Handbook (FSH 1909.12). BTNF monitoring program was updated in September 2016 for consistency with the 2012 planning regulations [36 CFR 219.12 (c) (1)]. BTNF Forest Plan was administratively changed to include the updated monitoring program. Monitoring questions and indicators were selected to inform the management of resources on the plan area and not every plan component was determined necessary to track 36 CFR 219.12(a) (2). Public input on these monitoring questions and indicators was incorporated into the monitoring guide. The monitoring guide is part of the overall plan monitoring program and provides more specific direction for implementing the more strategic plan monitoring program and details monitoring methods, protocols, and roles and responsibilities. The monitoring guide is not part of the plan decision and is subject to change as new science and methods emerge. The monitoring guide is available at: https://www.fs.usda.gov/main/btnf/landmanagement/planning.

Providing timely, accurate monitoring information to the responsible official and the public is a key requirement of the plan monitoring program. While implementation monitoring is important for tracking progress and accomplishments, it is effectiveness and validation monitoring that drive and support the adaptive management process. Effectiveness monitoring evaluates condition and trend relative to desired conditions. Validation monitoring tests hypotheses and provides information that might necessitate changes to desired conditions in the plan (e.g. is what we think the desired state should be really accurate?). In the context of forest planning there are three main monitoring goals:

- Are we implementing the Forest Plan implemented properly? Are we meeting our management targets and project guidelines? (implementation monitoring)
- Are we achieving our Forest Plan management goals and desired outcomes? (effectiveness monitoring)
- Does our hypothesis testing indicate we may need to change the Forest Plan? (validation monitoring)

Monitoring Evaluation

The following sections present the most current information for all monitoring questions and indicators contained within the Bridger Teton Forest Plan monitoring program. Monitoring questions are presented in order of how they address the eight monitoring categories required under the 2012 planning rule:

- status of select watershed conditions
- status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems (e.g. air, water, vegetation)
- status of focal species to assess the ecological conditions required under 36 CFR 219.9
- status of a select set of ecological conditions required under 36 CFR 219.9 to contribute to the recovery of federally threatened and endangered species, conserve proposed and candidate species and maintain a viable population of each species of conservation concern (At this time, SCC have not been identified for Bridger-Teton National Forest; therefore the Forest Plan monitoring program will not address SCC)
- status of visitor use, visitor satisfaction and progress toward meeting recreation objectives; measurable changes in the plan area related to climate change and other stressors that may be affecting the plan area
- progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities
- effects of each management system to determine that they do no substantially and permanently impact the productivity of the land (16 U.S.C. 1604(g)(3)(C)).

Question WTR-01: In what condition are the watersheds?

Indicator WTR-01-01: Multiple indicators from the Forest Service Watershed Condition Framework which includes both physical, biological, aquatic and terrestrial variables that affect watershed condition.

Summary of methodology

Watershed condition is assessed using the Watershed Condition Framework (WCF) (USDA Forest Service 2011); methodology can be found at: https://www.fs.fed.us/naturalresources/watershed/condition_framework.shtml. Each watershed is evaluated based on what has occurred in the watershed and by utilizing established procedures and metrics. A determination is then made of the condition class of the watershed. Each watershed is assigned a condition class: Class 1—Functioning Properly; Class 2—Functioning at Risk; or Class 3—Impaired Function. Current watershed condition classes on BTNF are available online (https://www.fs.fed.us/naturalresources/watershed/condition_framework.shtml). In addition to being assigned a condition class, each watershed was also assigned a conditional class rating. Ratings are a

numerical value developed by taking a weighted average of individual scores of 12 national core indicators, which include physical, biological, aquatic and terrestrial variables. In 2011, all sixth-level watersheds on the Bridger-Teton National Forest were evaluated and assigned a class and rating using the Watershed Condition Framework. Current watershed condition classes for BTNF can be accesses via the Watershed Condition and Prioritization Interactive Map website: https://apps.fs.usda.gov/wcatt/.

Monitoring results

There are 171 sixth level watersheds on BTNF. Of these, there are 157 which are Functioning Properly and 14 which are Functioning at Risk. During 2017 and 2018; one watershed (Fall Creek) on BTNF improved a condition class rating while the remaining watersheds' condition class rating remained stable. In 2015, the Fall Creek watershed was designated a priority watershed and restoration efforts were focused on this watershed. Essential projects were planned and implemented over the course of three years. In Fiscal Year 2018, all essential projects within the watershed had been completed which allowed the condition class to be improved from a rating of 1.61 to a rating of 1.28.

Discussion and findings

Overall, watershed condition across BTNF is improving. Restoration and enhancement activities by the USFS improved a condition class rating of the Fall Creek watershed.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Question AIR-01: Are air quality related values being impacted with wildness areas and other areas of the forest?

Indicator AIR-01-01: Lake water chemistry

Summary of methodology

Long-term lake chemistry sampling in the Bridger Wilderness was conducted at Hobbs, Black Joe, Deep, and Upper Frozen Lakes. Inlet and outlet samples are collected three times each year across (Spring, summer and fall) and hypolimnion and epilimnion samples collected one time per year (summer) for a total of 25 samples per year, not including replicates; only one sample is collected each year at Upper Frozen Lake due to access. Synoptic Lake sampling was conducted at six lakes in the Gros Ventre Wilderness in 2017 and one lake in the Bridger Wilderness in both 2017 and 2018. In 2017, samples from the Gros Ventre Wilderness arrived to the lab warm and more than 14 days since sampling; the sample quality is questionable. In 2017 and 2018, long-term lake sampling was conducted at four lakes for three seasons (early-summer, mid-summer, and late fall) in the Bridger Wilderness, as has happened every summer since 1984. A total of 25 samples were collected. Sampling methodology is outlined in (Grenon and others 2010)

New science or information

The Environmental Protection Agency (EPA) is developing an online mapping tool called the Critical Load Mapper, which will allow users to view and download nitrogen (N) and sulfur (S) deposition data across the continental US as well as identify lakes that are exceeding critical loads for acidification and eutrophication. This tool will take into account synoptic lake chemistry data. The Critical Loads Mapper tool should be available with lake acidification exceedances of N and S deposition by the next biennial monitoring report. Future updates of the Critical Loads Mapper will be

able to identify lakes at risk for acidification and eutrophication using N deposition loading, lake chemistry, and estimated CLs, though the timeline may be beyond 2020.

Monitoring results

Only three trends (out of a possible 25) in acid neutralizing capacity (ANC) were found. ANC was increasing at Upper Frozen (1997-2008) and decreasing at the outlets of Black Joe and Hobbs in fall, indicating that ANC has been generally stable at the various locations (inlet, outlet, hypolimnion, and epilimnion). ANC was decreasing throughout the three seasons for the long-term lakes analyzed. Grenon and others 2010 also found that there has been an increase in nitrate at the inlets of Black Joe and Deep lakes during fall and an increase in ammonium at Hobbs lake during early and late Summer from 2000-2010 (Grenon and others 2010). However, data collected since 2010 has not been analyzed; we do not know if these earlier trends have continued and what that means for overall health of aquatic ecosystems.

Discussion and findings

Many high alpine lakes are sensitive to deposition of air pollutants because sparse vegetation and shallow soils limit a lake basin's buffering capacity. Acidifying pollutants can cause acidification (i.e. (anions), such as sulfate and nitrate) or eutrophication (i.e. ammonium and phosphate) of these waterbodies to the point where animal and other aquatic life may decline or cease to exist. If pollutant levels are high enough and reach the point of acidification, the lake may no longer be suitable habitat for its aquatic residents. On the other end of the spectrum, pollutants that contain cations, such as ammonium or phosphate, may result in eutrophication (i.e. an increase in nutrients that causes algae to bloom to the point where animal and other aquatic life decline or cease to exist).

Grenon and others 2010 found that ANC was mostly stable at the four long-term lakes sampled in the Bridger Wilderness (Hobbs, Deep, Black Joe, and Upper Frozen). The most prominent trends were increases in nitrate at the inlets of Black Joe and Deep lakes during early fall and an increase in ammonium at Hobbs Lake during early and late summer. Modeled CL exceedances for nutrient enrichment show that the largest exceedances on BTNF are likely occurring in the Bridger Wilderness.

Sensitive waterbodies are most influenced by local, regional, and long-distance transport of pollutants from off-forest activities. Forest Service activities probably are not influencing changes in lake chemistry at a broad scale, thus no changes to management activities are warranted at this time.

Adaptive management considerations

Currently no changes to the monitoring program are warranted, but may be needed in the future as changes are made to the EPA's Critical Load Mapping Tool. It would also be beneficial to analysis the last ten years of lake chemistry sampling and reassess the trends found in (Grenon and others 2010).

New air quality management direction at the Forest level is warranted, but not urgent. The current Forest Plan does not address eutrophication, only acidification. The current plan air quality language is site-specific and outdated.

Indicator AIR-01-02: Critical Load exceedances from nitrogen deposition

Summary of methodology

To assess nitrogen pollution, BTNF uses National Atmospheric Deposition Program (NADP) data for wet deposition information and trends, the Clean Air Status and Trends Network (CASTNET) data for dry deposition information and trends, U.S. Geological Survey (USGS) snowpack data to supplement information and the U.S Environmental Protection Agency (EPA) Critical Loads Mapper tool to incorporate modeled N deposition amounts. Monitoring protocols are described in detail in BNTF

Monitoring Guide. There are four NADP sites representatives of BTNF: Gypsum Creek (WY98, est. 1984) located in the Upper Green River; Pinedale (WY06, est. 1982) located North of Pinedale; Grand Teton National Park (WY94, est. 2011); and South Pass City (WY 97, est. 1985) located at the southern tip of the Wind River Range. There are two CASTNET sites representative of BTNF: YEL408 which is run by Yellowstone National Park and PND165 in Pinedale which is run by EPA. There are eight USGS snow sampling sites in and around BTNF. In 2018, two new USGS high elevation remote sites were added at Hobbs Lake and Black Joe Lake outlet to replace the wintertime bulk deposition collection program that ended in 2017.

New science and information

Nanus et al 2017 Study

Nanus and others developed estimated annual wet deposition maps in the Greater Yellowstone Area for nitrate, ammonium, and dissolved inorganic nitrogen wet deposition (at 400 meter scale) (Nanus and others 2017). Total nitrogen (TN) deposition (wet + dry, including organic N) and critical load (CL) estimates and exceedances of TN deposition and exceedances were also mapped (4 km resolution) (Nanus and others 2017). The study used existing concentration and deposition data from 1993-2014 including data from NADP, CASTNET, USGS snowpack, IMPROVE, and USFS lake chemistry sampling in combination with gridded dry deposition estimates. Nitrate concentrations from 125 lakes were used to help develop the modeled results. Ground truthing of this model was conducted as part of a new project in the summer 2018 and results should be available by the next biennial report.

Critical Loads Mapper

A new version of EPA's Critical Loads Mapper tool is under development and due for release by spring 2019. This new version will include updates to TDEP and existing CL information, plus the addition of CL information for individual tree species survival and growth and epiphytic lichens. A contractor is currently working with EPA to gather all the relevant CL information for the Intermountain Region in preparation for Forest Plan Revision Assessment work. Information for BTNF will be available in 2019. Future Biennial reports will be able to download needed information directly from the Critical Loads Mapper tool.

Monitoring results

Nitrogen deposition via NADP

Data from 2018 were not available by the time of this report. From 2016-2017, total inorganic nitrogen (IN) deposition ranged from 1.05 – 2.055 kg N/ha/yr, while from 1982-2017 it ranged between 0.29-2.12 kg N/ha/yr (TABLE 3). Ammonium made up a greater proportion of IN deposition than nitrate at all sites, sometimes twice as much.

Table 3. Annual wet deposition for nitrogen from ammonium, nitrate, and total inorganic nitrogen (IN) during 2016 and 2017 at selected BTNF NADP monitoring sites

Monitoring site	Year	Ammonium (NH4)	Nitrate (NO3)	Total Inorganic Nitrogen
WY98	2016	1.390	0.534	1.923
	2017	0.677	0.375	1.05
WY06	2016	0.604	0.404	1.007
	2017	1.227	0.652	1.878
WY94	2016	0.867	0.488	1.354
	2017	1.327	0.729	2.055
WY97	2016	0.829	0.596	1.424
	2017	0.887	0.513	1.399

Nitrogen deposition via CASTNET

At the time of this report, the CASTNET website was only updated through 2016. At YEL408, wet deposition from ammonium followed by dry deposition of ammonia made up the largest portion, over 50% of total N deposition (FIGURE 1). At PND165 from 2014-2016, dry deposition of ammonia followed by wet deposition of ammonium made up the largest portion, over 50%, of total N deposition (FIGURE 3). From 2014-2016, total N deposition ranged from 2.56-3.17 Kg N/ha/yr at PND165 and 3.28-3.60 Kg N/ha/yr at YEL408 (FIGURE 2, FIGURE 4). Total annual N deposition tends to be lower at PND165 because it is a drier site. Dry deposition makes up half to over half of total N deposition at the Yellowstone and Pinedale sites respectively. In addition to reduced and oxidized N, natural organic material (NOM) is also included in total N deposition amounts. Trends for individual N species were not analyzed.

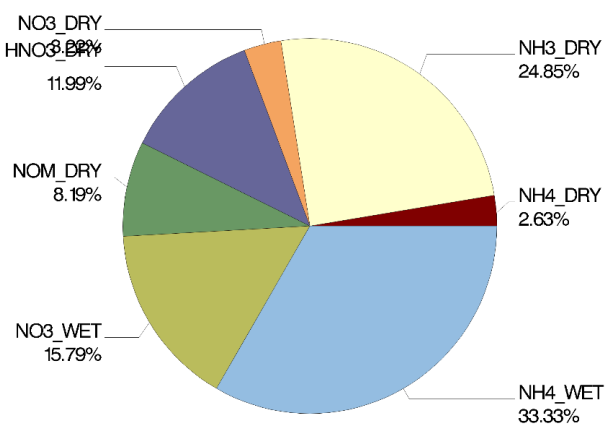

Figure 1. N deposition composition at YEL408 site

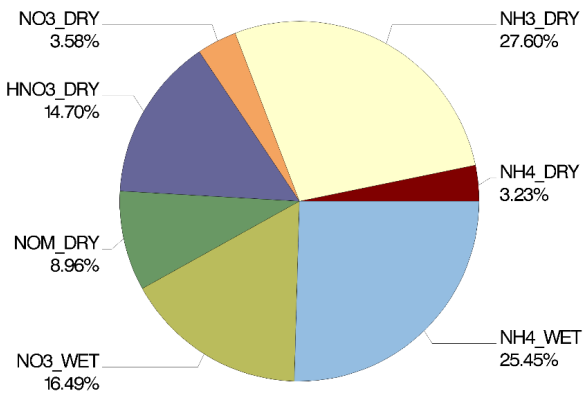

Figure 3. N deposition composition at PND165

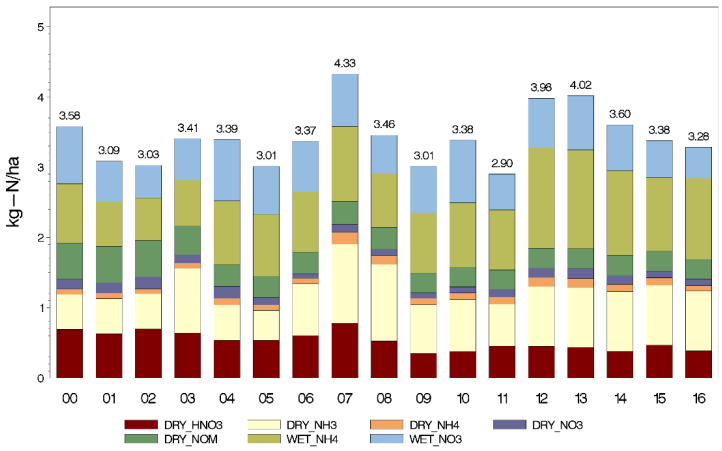

Figure 2. Total annual N deposition at the YEL408 CASTNET site.

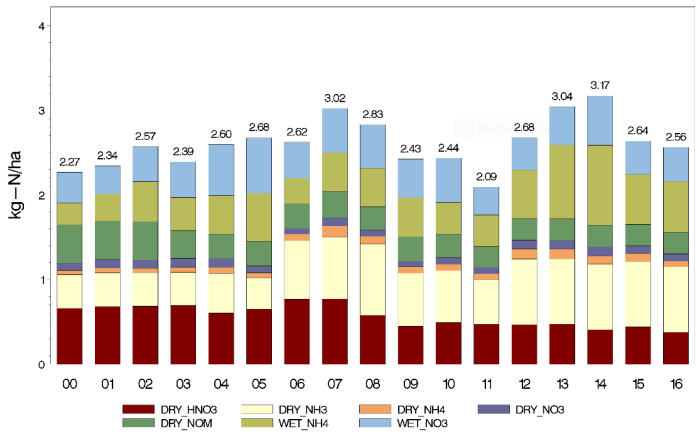

Figure 4. Total annual N deposition at the YEL408 CASTNET site

Nitrogen concentration via USGS snowpack

There is a significant increasing trend ($p < 0.001$) in ammonium concentration for the Greater Yellowstone Area (GYA) sites and the entire Rocky Mountain Region (RMR) study area (FIGURE 5). Not all sites on and around BTNF exhibit increasing ammonium concentration trends. There is a

significant decreasing trend ($p < 0.001$) in nitrate concentrations across the GYA and the RMR study area (FIGURE 6). This decreasing trend is apparent at all the sites on and around BTNF.

In 2018, ammonium deposition in the snowpack made up over 50% of inorganic nitrogen deposition (DIN) at all sites on BTNF and within the GYA (FIGURE 7). Nitrate concentrations were highest on BTNF in the Wind River Range. At both the Hobbs Lake & Elkhart sites, there were high amounts of DIN, ammonium, and nitrate deposition and concentrations. However, they were sampled one month after the other sites in the Wind River Range. In addition, there was over twice the snow water equivalent (SWE) at the Hobbs Lake, compared to the Elkhart site, which is seven miles to SW of Hobbs.

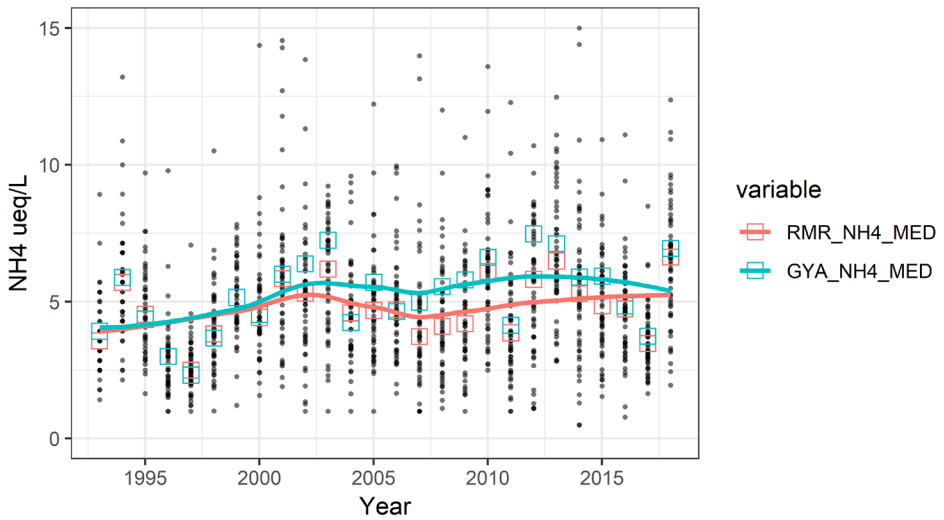

Figure 5. Trends in snowpack chemistry—ammonium concentrations, 1993-2018. An average of all sites in the Greater Yellowstone Ecosystem is shown in green and an average of all sites in the monitoring network is shown in red.

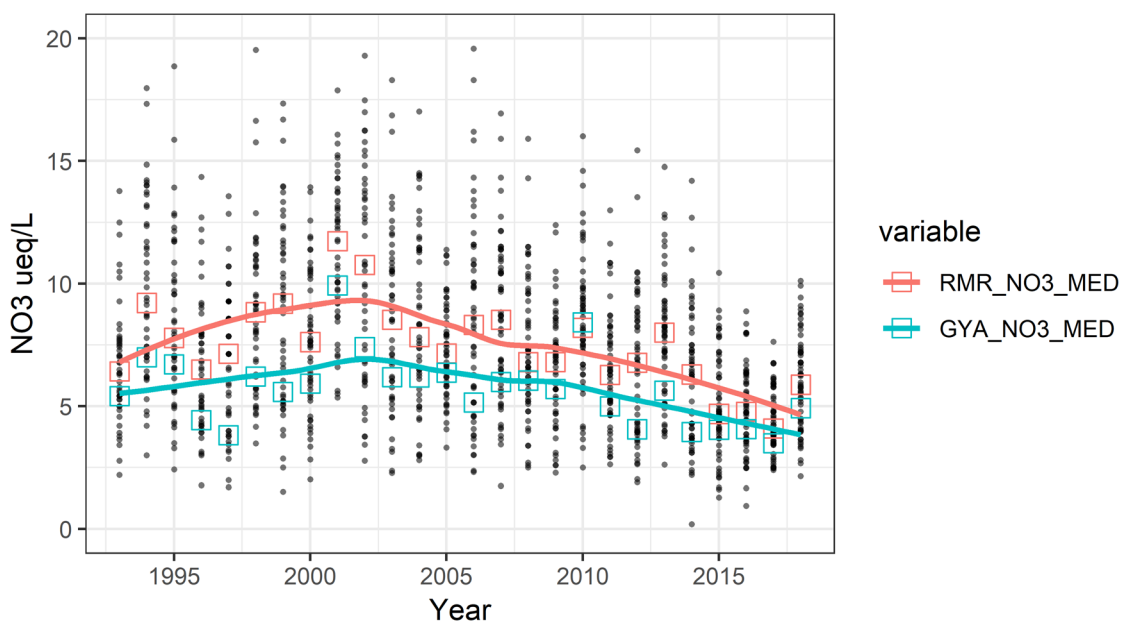

Figure 6. Trends in snowpack chemistry—nitrate concentrations, 1993-2018. An average of all sites in the Greater Yellowstone Ecosystem is shown in green and an average of all sites in the monitoring network is shown in red.

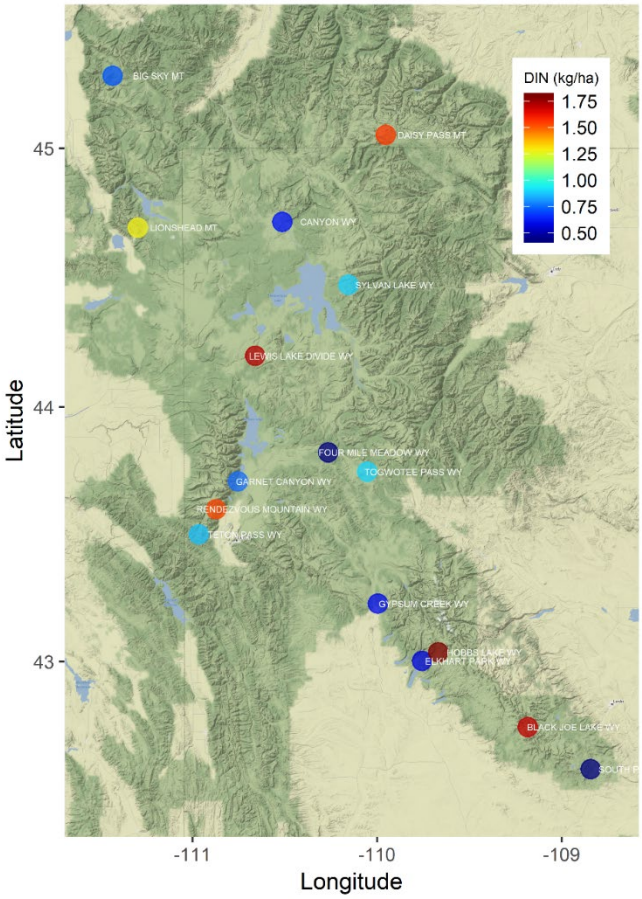

Figure 7. 2018 total inorganic nitrogen deposition (DIN) in kg/ha at USGS snow sampling sites around the Greater Yellowstone Area (GYA).

Critical load exceedances via Nanus et al. 2017 study

The model developed by Nanus et al. produced estimated annual wet deposition maps in the Greater Yellowstone Area for nitrate, ammonium, and dissolved inorganic nitrogen wet deposition. The model estimated that total nitrogen (TN), including organic nitrogen, ranged from 2.20-4.79 kg/ha/yr on BTNF (Nanus pers. comm. 2018). The percent of barren land in a lake basin was the greatest predictor of lake nitrate levels, which suggests that lake catchments with little vegetation and thin to no soil (most often the high alpine zone) are likely the most sensitive to TN deposition and thus have the lowest estimated CL. The highest CL exceedances were in the Bridger Wilderness which has a large number of alpine lakes with high percent barren land even though the areas with the most estimated N loading are on the western side of BTNF (FIGURE 8).

Lakes begin showing an increase in nitrate concentrations in response to TN deposition at 3.0 kg/ha/yr and a response to inorganic wet N deposition at 1.5 kg/ha/yr.

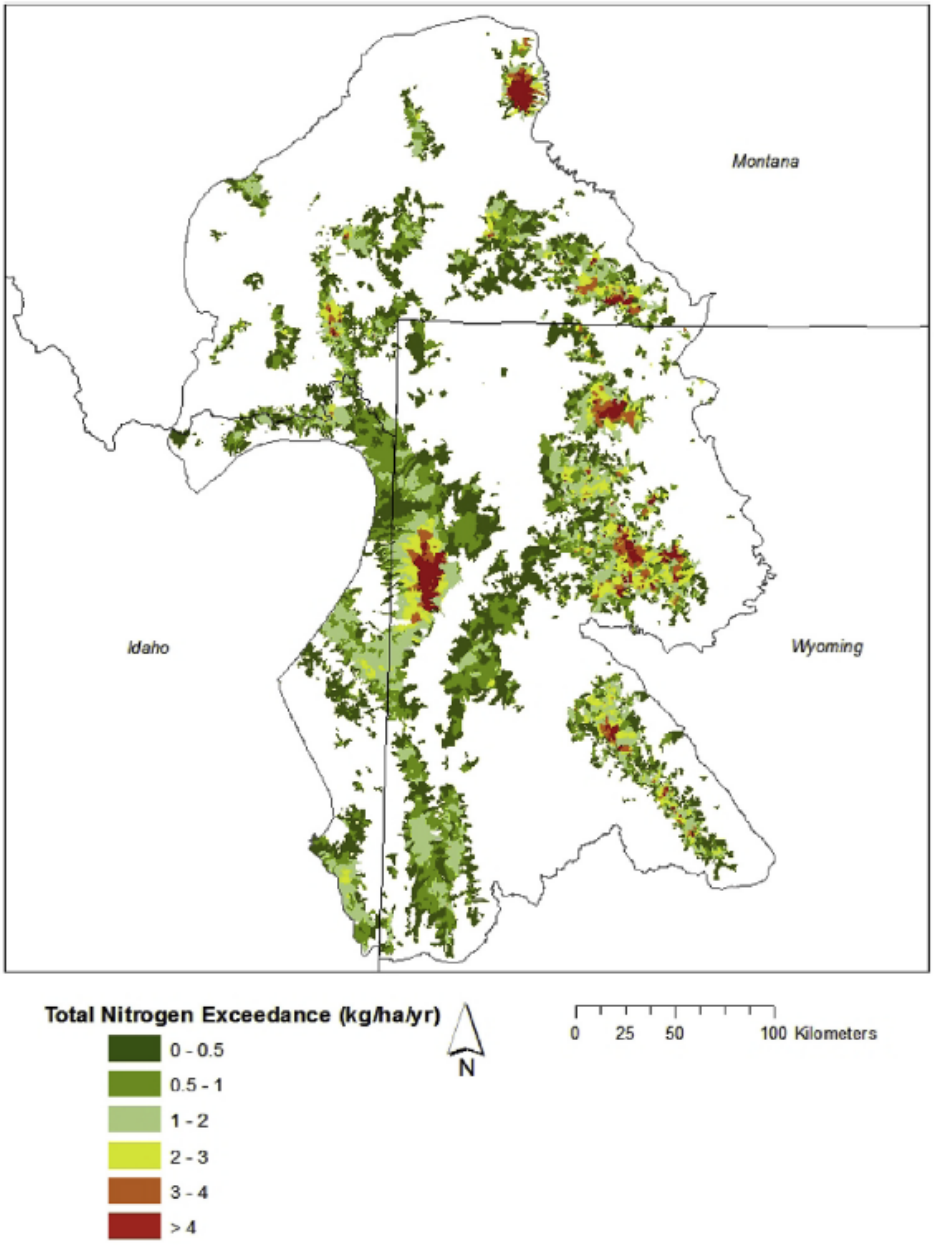

Figure 8. Modelled total N exceedance for Greater Yellowstone Ecosystem based on a nitrate threshold of 1.0 µmol L^{-1}. From (Nanus and others 2017)

Discussion and findings

Deposition from air pollutants occurs when the ambient pollutant precipitate out (wet, dry, fog) and deposits onto the earth. Deposition from air pollution including nitrogen species can negatively impact ecosystem function and degrade key resources such as clean water and tree health. A critical load (CL) is a measure that quantifies atmospheric deposition loading on the landscape—usually in Kg N/ha/yr—attaching a number to different ecosystem components, below which no harmful effect will occur (Umweltbundesamt (UBA) 2004). Knowing critical load for a landscape can help inform management decisions. CL for N deposition varies depending on the ecosystem component (i.e. diatoms, lichens, trees survival or growth (Pardo and others 2011)). CL exceedance for nitrogen

deposition have been linked to ecosystem eutrophication or acidification and degradation of sensitive ecosystem components (Baron and others 2011; Bobbink and others 2010; Fenn and others 2003).

Background (pre-industrial) inorganic nitrogen deposition in the northern Rockies forested ecosystems is estimated at ≤ 1 kg N/ha/yr (Holland et al. 1999; Sverdrup et al. 2012). Total nitrogen deposition measured within the last two decades on the BTNF ranged between 0.78 - 4.33 kg N/ha/yr, with wet deposition ranging from 0.29 - 2.12 kg N/ha/yr. Modeled estimates of N deposition tend to be higher in part because organic N is often included and the models are tied to precipitation amounts. Ammonium-N deposition is increasing on the BTNF and contributes more to total N than nitrate-N. Wet and total N deposition loading amounts indicate that parts of the BTNF including wilderness may be exceeding nitrogen CL for multiple sensitive ecosystem components.

Critical loads for diatoms in high alpine lakes of the Rocky Mountains has been estimated at 1.4 kg wet N/ha/yr (Saros and others 2011) and sensitive lakes respond to inorganic N deposition as low as 1.5 kg wet N/ha/yr (Nanus and others 2017). Inorganic total N deposition above 4.0-5.0 kg N/ha/yr in the Rocky Mountains has been associated lichen degradation, negative survival and growth curves for tree species and changes in mineralization, nitrification, and soil chemistry of subalpine forests (Fenn and others 2003; McMurray and others 2013; McMurray and others 2015; Pardo and others 2011; Williams and Tonnessen 2000). Measured inorganic N deposition (wet and dry) in and around BTNF between 2000 and 2016 (CASTNET) and 2010-2011 (McMurray and others 2013) has been between 0.78 - 4.33 kg N/ha/yr. This indicates that parts of BTNF are likely in exceedance for diatom assemblages, surface water, lichen, and tree nitrogen CL.

USGS snowpack data showed a higher percentage of ammonium in the snowpack for all sites in and around BTNF. Overall the snowpack sites in the GYA are increasing in ammonium deposition while decreasing in nitrate deposition. In addition, CASTNET and NADP showed higher proportions of reduced N (ammonium and ammonia) vs oxidized N (NOx) in the total N deposition measured at all sites. This likely reflects the success of rules and regulations limiting and decreasing NOx emissions, such regulations have not been applied to decrease reduced N emissions.

Forest Service activities are not likely contributing to N deposition at a broad scale. Changes in deposition are mostly influenced by local, regional, and long-distance transport of pollutants from off-forest activities.

Adaptive management considerations

Currently no changes to the monitoring program are warranted, but may be needed in the future as changes are made to the EPA's Critical Load Mapping Tool. No change to management activities is warranted at this time.

New air quality management direction at the Forest level is warranted, but not urgent. The current Forest Plan lacks direction in regards to atmospheric deposition. Only reference to atmospheric deposition is that there is an "ongoing watershed study in the Green River Basin and Teton Wilderness". Deposition needs to be assessed for both aquatic and terrestrial effects across BTNF, not just in one watershed study. In addition, the current plan language is outdated and not inclusive.

Indicator AIR-01-03: Visibility

Summary of methodology

Visibility has been monitored with the Interagency Monitoring of Protected Visual Environments (IMPROVE). IMPROVE monitors collect ambient air samples in 24 hour cycles every three days throughout the calendar year. More information about the IMPROVE program including data can be found at http://vista.cira.colostate.edu/improve/ and http://views.cira.colostate.edu/fed/. There are two IMPROVE monitors on the Bridger-Teton National Forest: BOLA1 which is at Boulder and BRID1

which is on the White Pine Ski Area. There is also an IMPROVE monitor in Yellowstone National Park (YELL2). BOLA1 and BRID1 reflect visibility in the Bridger Wilderness and YELL2 is representative of the Teton Wilderness. A new metric in IMPROVE looks at impairment, focusing on haze caused by anthropogenic emissions while decreasing the variability caused by smoke from wildland and prescribed fires and other natural emissions. The IMPROVE program is shifting towards using this metric in lieu of hazy days.

Monitoring results

From 1989-2018, visibility at all three IMPROVE sites has increased significantly on the clearest days. The clearest days occur in December and January at all three sites. On the clearest days haze is primarily made up of ammonium sulfate (42%, 43%, 37%) and organic carbon (24%, 21%, 28%) at BRID1, BOLA1, and YELL2 respectively.

The haziest days do not show any significant trends. The haziest days occur from April through September, with April and May having the most impaired days at all three sites from 1989-2018. On the haziest days, organic carbon (46%, 52%, 53%) and ammonium sulfate (24%, 18%, 15%) make up the bulk of the haze at BRID1, BOLA1, and YELL2 sites respectively.

In terms of impairment (haze caused by anthropogenic emissions), on the most impaired days ammonium sulfate contributed a larger portion light extinction at BRID1, BOLA1, and YELL2 respectively (45%, 47%, and 36%), whereas organic carbon contributed less (23%, 21%, and 28% respectively)

From 2012-2017, ammonium sulfate, organic carbon, and ammonium nitrate are the largest contributors to haze on the clearest days at all three sites. In 2017-2018, there was an increase in the proportion of ammonium sulfate and ammonium nitrate that are contributing to the haze compared to the whole period of record (1989-2018). Ammonium sulfate and organic carbon are also the largest contributors to haze on the most impaired days.

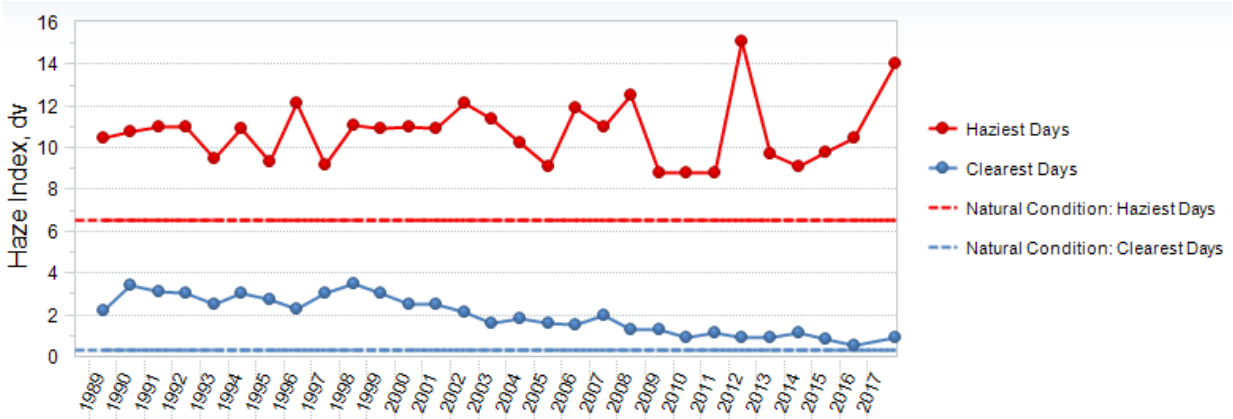

Figure 9. Visibility of Haziest & Clearest Days, Bridger IMPROVE site

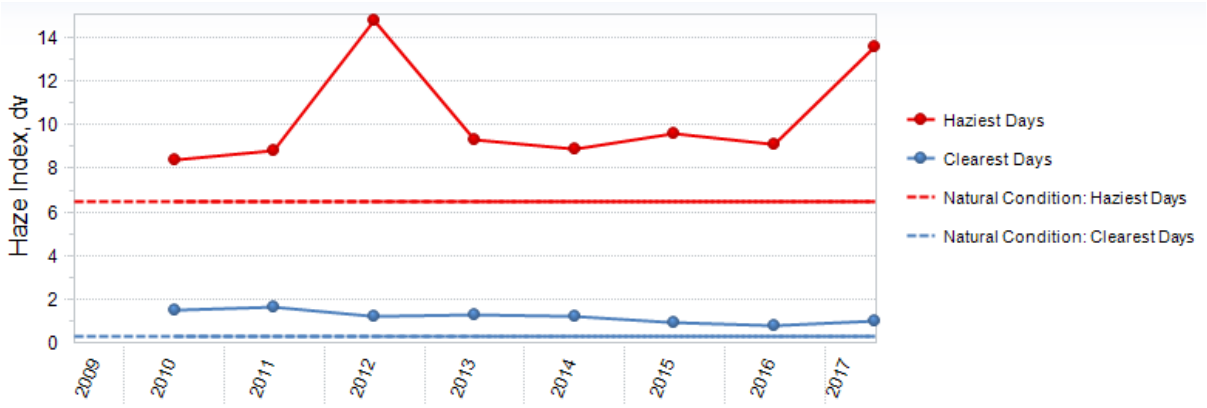

Figure 10. Visibility of Haziest & Clearest Days, Boulder Lake IMPROVE site

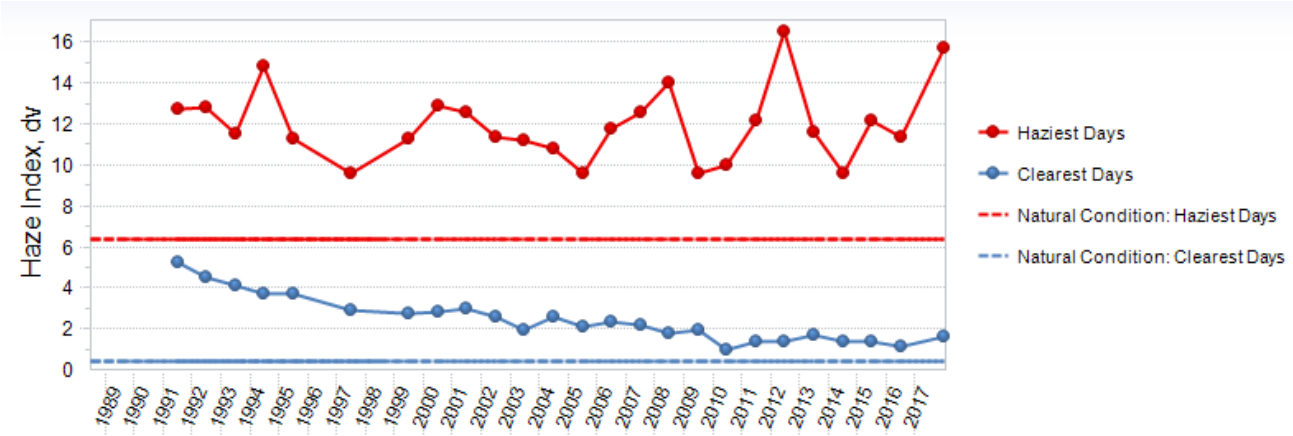

Figure 11. Visibility of Haziest & Clearest Days, Yellowstone IMPROVE site

Discussion and findings

Visibility on BTNF continues to improve on the clearest days, while the haziest days show no trends. This likely reflects the variability of smoke from wildland fires which masks the effects of anthropogenic emission reductions. Timing, duration and extent of wildland fire are difficult to control and the ability to control for any given fire—in terms of its air quality impacts—are largely outside the scope of BTNF's Forest Plan. Nonetheless, prescribed burning can also degrade air quality by adding additional smoke and particulates. Air quality considerations are incorporated into prescribed burning plans on BTNF and BTNF will continue to monitor air quality when conducting prescribed burns.

Adaptive management considerations

Based upon the monitoring results, no change to the monitoring program is warranted. In the current forest plan, there is only one standard that addresses smoke management in prescribed burning. Changes to both the Forest Plan and management activities may be warranted, but are not considered urgent.

Question VEG-01: To what extent is vegetation being impacted by management activities and natural disturbance processes?

Indicator VEG-01-01: Acres in each biophysical setting affected by vegetation management activities

Summary of methodology

To calculate acres of vegetation within each biophysical setting (BPS) that have been manipulated through some level of treatment, one of the Forest Service's corporate databases—Forest Activity Tracking System (FACTS)—was queried for commercial timber harvest, pre-commercial thinning, non-commercial (fuels) thinning and prescribed burning treatments for fiscal years 2015-2018 (Oct 2014-Sep 2017). FACTS is a part of the Forest Service's the Natural Resource Manager (NRM) system; information about these databases is available at http://fsweb.nrm.fs.fed.us/. Results are separated into those that are primarily associated with commercial timber harvest (e.g. commercial thin, improvement cut, sanitation cut, salvage cut, shelterwood establishment & removal, sanitation cut, clearcut) and fuels treatments (e.g. non-commercial thinning, prescribed burning); treatments with a secondary objective of fuels were included in timber harvest. Prescribed burning is tracked by calendar year. During spatial analysis of prescribed fire data, it was determined that several prescribed burn treatments lacks spatial components. Adjustments in the analysis were made & the missing polygons will be entered in FACTS.

BPS is derived from the 2014 LandFire Biophysical Conditions (https://www.landfire.gov/bps.php). BPS represents vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance regime. Additional background information regarding historic burn treatments before 2015 were derived from FACTS and BTNF vegetation program records.

Monitoring results

Timber harvest treatments

TABLE 4 summarize extent of timber harvest and associated treatments across BPS. In terms of location, treatments were concentrated in Rocky Mountain Mesic (1,549 ac) and Aspen (1,259 ac) BPS types (TABLE 4). FIGURE 13, FIGURE 12 and FIGURE 14 illustrate the acres of each commercial timber harvest type within the three BPS where timber activities are concentrated on BTNF: Rocky Mountain Subalpine Dry-Mesic Spruce-Fire Forest and Woodland; Rocky Mountain Aspen Forest and Woodland; and Intermountain Basins Aspen-Mixed Conifer Forest & Woodland. The majority of acres were treated via salvage cuts, sanitation cuts, and commercial thinning.

Table 4. Total acres of timber harvest in all biophysical settings, 2015-2018

	Acres Treated by Fiscal Year				
Biophysical Setting	**2015**	**2016**	**2017**	**2018**	**Grand Total**
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	318	381	226	74	1,000
Rocky Mountain Subalpine-Montane Mesic Meadow	1	466	1	82	549
Rocky Mountain Aspen Forest and Woodland	2	448	1	20	472
Rocky Mountain Alpine/Montane Sparsely Vegetated Systems		430			430
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	55	251	31	18	355
Northern Rocky Mountain Subalpine Woodland and Parkland	31	169	63	46	310
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	17	242	13	5	278
Xeric Montane Douglas-fir Forest	26	247	0	3	276
Inter-Mountain Basins Montane Sagebrush Steppe		202	0	0	203
Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland	61	109	18	0	188
Rocky Mountain Lodgepole Pine Forest	23	66	30	18	136
Artemisia tridentata ssp. vaseyana Shrubland Alliance	1	131	1	1	133
Subalpine Douglas-fir Forest	0	112	0	2	114
Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	0	80	0	1	82
Northern Rocky Mountain Subalpine Deciduous Shrubland	0	52	0		52
Northern Rocky Mountain Subalpine-Upper Montane Grassland	0	22	0	1	24
Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	0	22			22
Barren		21			21
Introduced Upland Vegetation-Perennial Grassland and Forbland		18			18
Rocky Mountain Bigtooth Maple Ravine Woodland		12			12
Western Cool Temperate Urban Shrubland	0	9			9
Inter-Mountain Basins Big Sagebrush Steppe		8			8
Western Cool Temperate Urban Herbaceous		8			8
Western Cool Temperate Urban Mixed Forest	0	3			3
Western Cool Temperate Developed Ruderal Shrubland		3			3
Rocky Mountain Foothill Limber Pine-Juniper Woodland		3			3
Western Cool Temperate Developed Ruderal Grassland		3			3
Western Cool Temperate Urban Evergreen Forest	1	2			3
Rocky Mountain Montane Riparian Forest and Woodland		3			3
Developed-Medium Intensity		3			3
Northern Rocky Mountain Conifer Swamp	0	2	0	0	3
Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	0	2	0		2
Inter-Mountain Basins Mixed Salt Desert Scrub		2			2
Rocky Mountain Alpine Dwarf-Shrubland		2			2
Developed-Roads	0	1			2
Developed-Low Intensity		1			1
Mesic Montane Douglas-fir Forest		1			1
Western Cool Temperate Urban Deciduous Forest	1	0			1
Snow-Ice		1			1
Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	0	1		0	1
Rocky Mountain Poor-Site Lodgepole Pine Forest	0				0
Rocky Mountain Subalpine/Upper Montane Riparian Forest and Woodland	0				0
Rocky Mountain Montane Riparian Shrubland				0	0
Grand Total	**539**	**3,544**	**386**	**273**	**4,741**

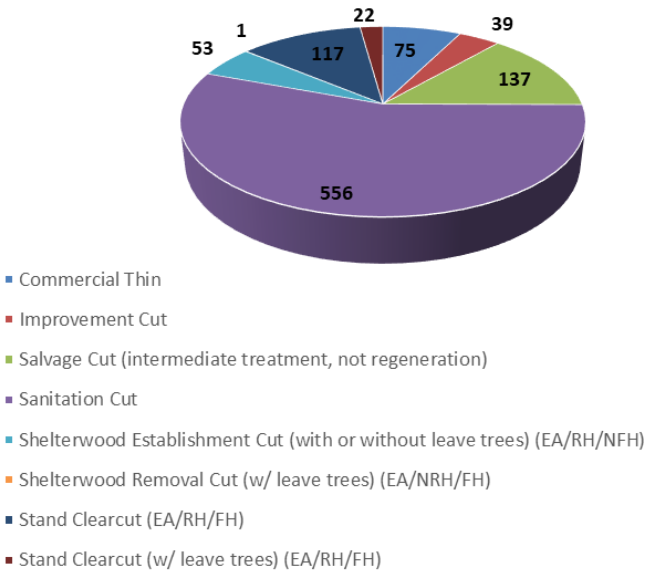

Figure 12. Total acres in Rocky Mountain Subalpine Dry-Mesic Spruce-Fire Forest and Woodland, by timber treatment type, FY15-18

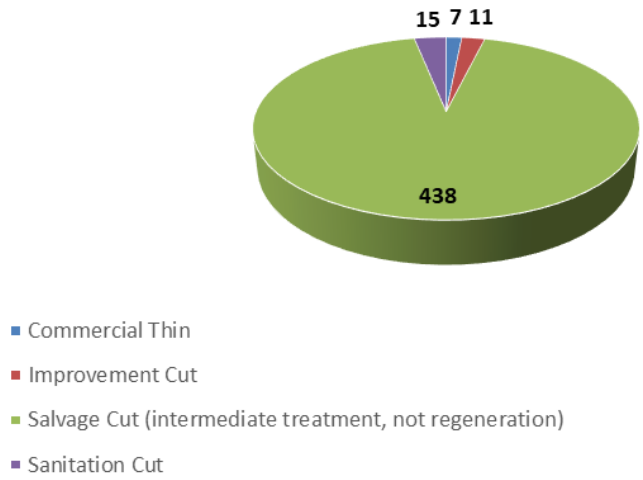

Figure 14. Total acres treated in Rocky Mountain Aspen Forest and Woodland, by timber treatment type, FY15-18

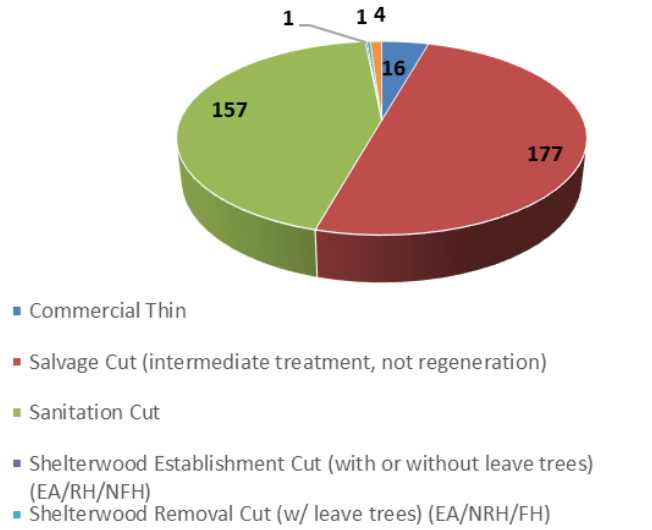

Figure 13. Total acres treated in Intermountain Basins Aspen-Mixed Conifer Forest & Woodland, by timber treatment type, FY15-18

Fuels Treatments

Approximately 5,063 acres of mechanical fuels treatments were conducted in fiscal years 2015-2018 (FIGURE 15). Most projects included several different activities that overlap spatially; actual footprint acreage treated is less than the reported fuels activities acres. From 2015-2018, a footprint of approximately 1,600 acres were treated. The majority of these treatments were strategically located adjacent to the Wildland Urban Interface (WUI) with the primary objective of reducing potential fire intensity under most weather and fuels conditions. With the exception of burning, most of these treatments were contracted to private companies with an estimated average cost is $1,400/acre.

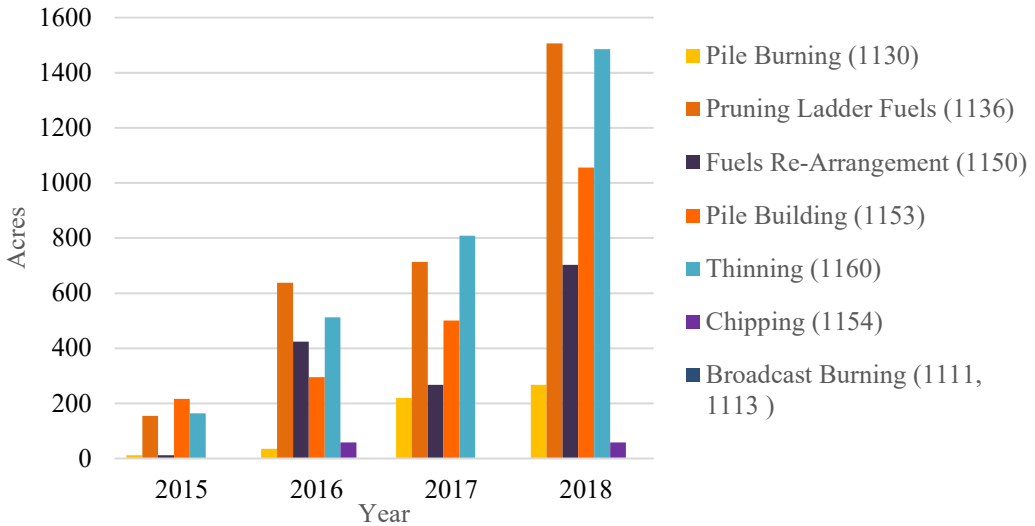

Figure 15. Total acres of fuels treatments, FY15-18

A total of 3,043 acres of prescribed burning were implemented from 2015-2018. From 2017-2018, average acres burned per year was 740 acres per year; the 44-year average of 1,824 acres per year. Confidence for the accuracy of the acres treated for both mechanical fuels treatment and prescribed burning is high. Four of the prescribed burns conducted in 2015-2018 were analyzed to determine what vegetation types were treated (TABLE 5). The most common vegetation type in which burns were conducted was aspens (29%) or big sagebrush steppe (40%).

Table 5. Vegetation types treated in four select prescribed burns, 2015-2018

Vegetation type	Acres
Aspen Forest, Woodland, and Parkland	164
Aspen-Mixed Conifer Forest and Woodland	26
Big Sagebrush Shrubland and Steppe	267
Developed-Upland Shrubland	5
Limber Pine Woodland	3
Spruce-Fir Forest and Woodland	186
Subalpine Woodland and Parkland	10
Total	**661**

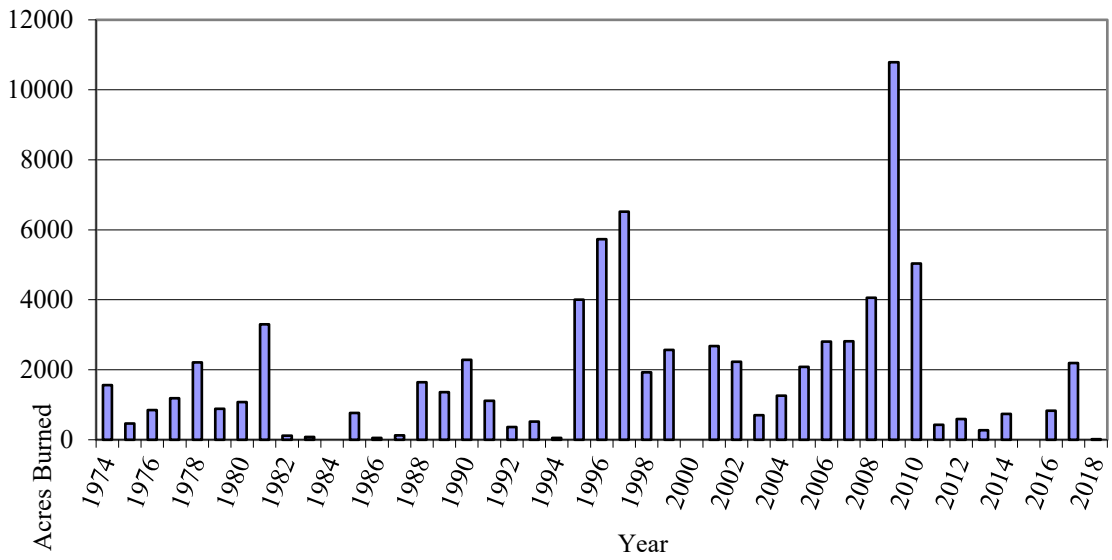

Figure 16. Acres treated via prescribed burning, 1974-2018

Discussion and findings

Timber treatments

There are several reasons why timber treatments are concentrated in Rocky Mountain Mesic and Rocky Mountain Aspen BPS (TABLE 4). Many BPS on BTNF are only found on very few acres or lack high value timber species (or both); these BPS are not the focus of commercial harvest, as reflected in TABLE 4. Sanitation treatments were concentrated in Rocky Mountain Subalpine Dry Mesic Spruce Fir Forest because this forest type is more susceptible to forest pest infestations. This BPS is also the focus of commercial timber harvest due to having more highly valued timber species. The concentration of salvage logging in Rocky Mountain Aspen Forest and Woodland and Intermountain Basin Aspen-Mixed Conifer Forest and Woodland is due to these vegetation types having suffered higher levels of mortality resulting from Mountain Pine Beetle (MPB), Spruce Beetle, and wildfire. Salvage, sanitation, and commercial thinning treatments are focused within aspen stands to directly address a Forest Plan objective to reduce conifer encroachment and restore ecological function. Furthermore, salvage operations outside aspen stands are in alignment with Forest Plan objectives to address catastrophic events (e.g. beetle kill, wildfire) in a timely manner.

Fuels treatments

Over the past five years, there has been a decrease in acres of fuels treatments, due in large part to a decrease in the number and size of prescribed burns. Prescribed burning treatments have fluctuated over the past 40 years (FIGURE 16). There was a large increase from 2002-2009, when several large burns were successfully implemented, followed by a decrease from 2011-2018. Management of unplanned ignitions is an important fuels management tool utilized on BTNF. Since the 2004 amendment to the Forest Plan, BTNF has the ability to manage unplanned ignitions for resource value, rather than immediately suppress all ignitions.

The decrease in prescribed burn acres from 2011-2018 is likely due to a number of factors. The longer wildland fire season reduces the window for fire managers to conduct prescribed burning. An increased emphasis on mechanical treatment of WUI areas has limited staff capacity to plan and implement burns. Additionally, the Teton to Snake project, which planned for large-scale prescribed burning on the Jackson Ranger District was delayed until 2017; it will implement large-scale burning over the next ten years.

While prescribed burning has decreased, BTNF has been successful in increasing the amount of mechanical fuels treatments. Based on national and local direction, mechanical fuels treatment near Wildland Urban Interface (WUI) areas has been a key focus of fuels treatments during the past five years. The long-term goal is to treat these critical areas to allow more options managing prescribed and wildland fires in the future.

In terms of location of prescribed burning across BPS, from 2015-2018, burns appear to be focused in aspen and big sagebrush steppe. Most burning during this time was targeted at conifer encroachment in aspen stands. Aspens stands are often found within the sagebrush/grass BPS. Therefore, the concentration of burns in these BPS is an artifact of targeted burning, rather than a representation of desired conditions.

Adaptive management considerations

The current monitoring program indicators are considered appropriate, though there are some shortcomings. The current vegetation indicators separate affected vegetation into those affected by management actions and those affected by 'natural disturbance' (VEG-01-02). Depending on management strategy, these fires can be considered both natural and management-directed, so it can be difficult to draw conclusions from the data as reported. Furthermore, some vegetation treatment data is reported on a calendar year basis (e.g. uncontrolled fire), while some data is reported on a fiscal year basis (e.g. prescribed burning), so these data sets cannot be easily compared. The Forest Service is currently modernizing reporting systems; reporting has moved from strictly tabular data to a combination of geospatial and tabular reporting. These changes should improve data collation and analysis.

BTNF is actively undertaking management activities to address forest restoration, but the current Forest Plan lacks direction specifically focused on forest restoration. Ongoing and expected future increases in tree mortality resulting from insects, diseases and larger wildfires will likely lead to more acres of forest that require active restoration. Specific Forest Plan objectives will need to be identified to provide guidance on how to address these issues.

In terms of fuels treatment, no changes to the Forest Plan are warranted, but increasing opportunities to conduct more prescribed burning warrant consideration.

Indicator VEG-01-02: Acres affected by natural disturbance processes

Summary of methodology

According to the monitoring guide, natural disturbance processes could include unplanned ignitions (ex. wildfire); timber stand mortality resulting for insect and disease attack; landslides and large erosion events; flooding events that significantly alter vegetation condition. This indicator is addressed using geospatial data derived from remote sensing, national vegetation databases, fire incident maps and vegetation succession. Timber stand mortality resulting from insect and disease is concurrently addressed in Indicator EVS-01-01 and is discussed in that section. A forest-wide GIS review of landslides, large erosion events and flooding was conducted and did not reveal any significant events, so these are not addressed in this report. Spatial data on all unplanned fires over ten acres are archived in the Bridger-Teton GIS database. Additional supporting fire specific information is available through the National Fire and Aviation Data Warehouse. Wildfire data are not separated into natural or human-caused, so both are included as 'natural disturbance'.

Biophysical setting (BPS) is derived from the 2014 LandFire Biophysical Conditions (https://www.landfire.gov/bps.php). BPS represents vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment

and an approximation of the historical disturbance regime. BPS with less than 100 acres were excluded from analysis.

New science or information

Additional techniques are under development for remote mapping on wildland fires and analyzing fire severity and vegetation recovery.

Monitoring results

Since 1954, approximately 670,404 acres on BTNF have burned in wildfires (FIGURE 17). Overall, there has been an increase in the number of acres burned per year, but a decrease in ignitions detected (FIGURE 18). The large number of reported wildfires from 1978 -1981 was partially due to human ignitions directly related to seismic exploration (FIGURE 18). The largest fire season was 1988 with 270,000 acres burned and the next largest fire season was 2012 with 107,000 acres burned (FIGURE 17).

From 2015-2018, approximately 106,860 acres burned in wildfires on BTNF. Yearly burned acres ranged from 78 acres in 2015 up to 68,610 acres in 2018. From 2015-2018, lightning fires accounted for 44% and human caused fire for 56%, while the long-term (1954-2018) average is 57% lightning-caused and 43% human-caused fires. In terms of location, the majority of fires occurred in Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (27591 ac) and Rocky Mountain Aspen Forest and Woodland (13,862 ac) (FIGURE 19).

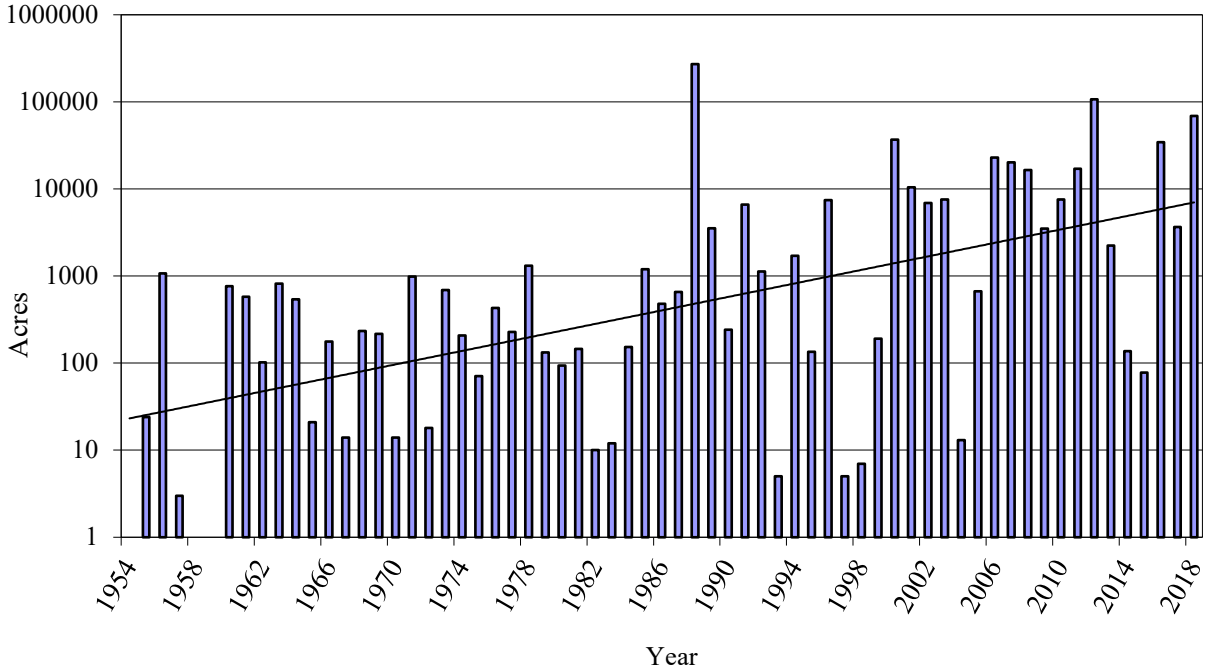

Figure 17. Acres burned by wildland on BTNF (Natural and Human Caused), 1954-2018. Scale is logarithmic.

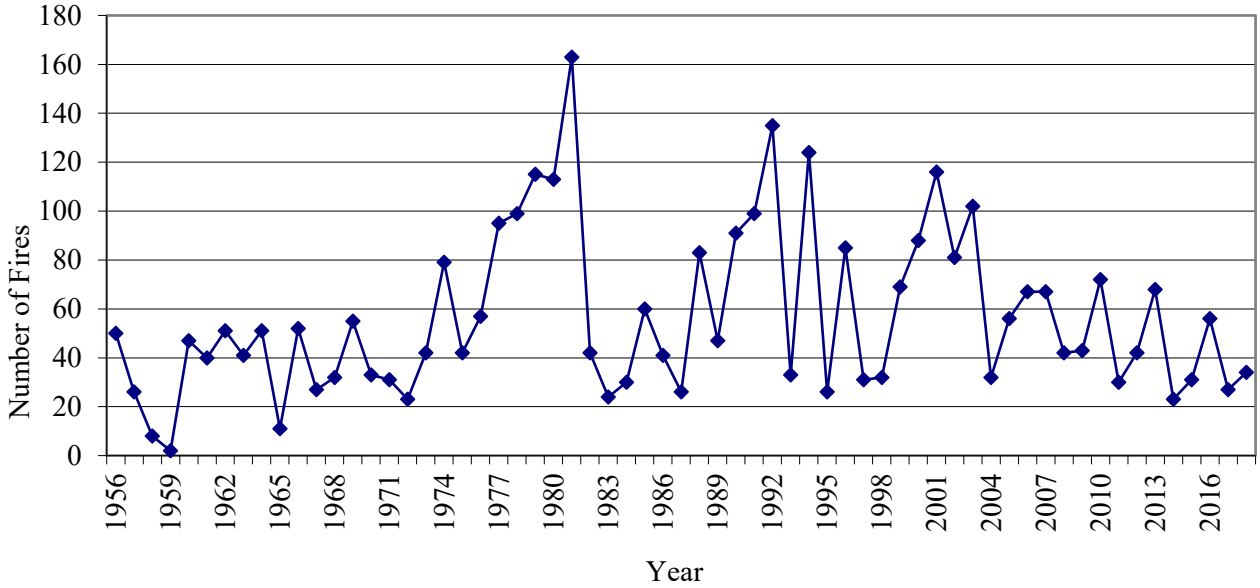

Figure 18. Number of wildfires on BTNF (natural and human caused), 1956-2018

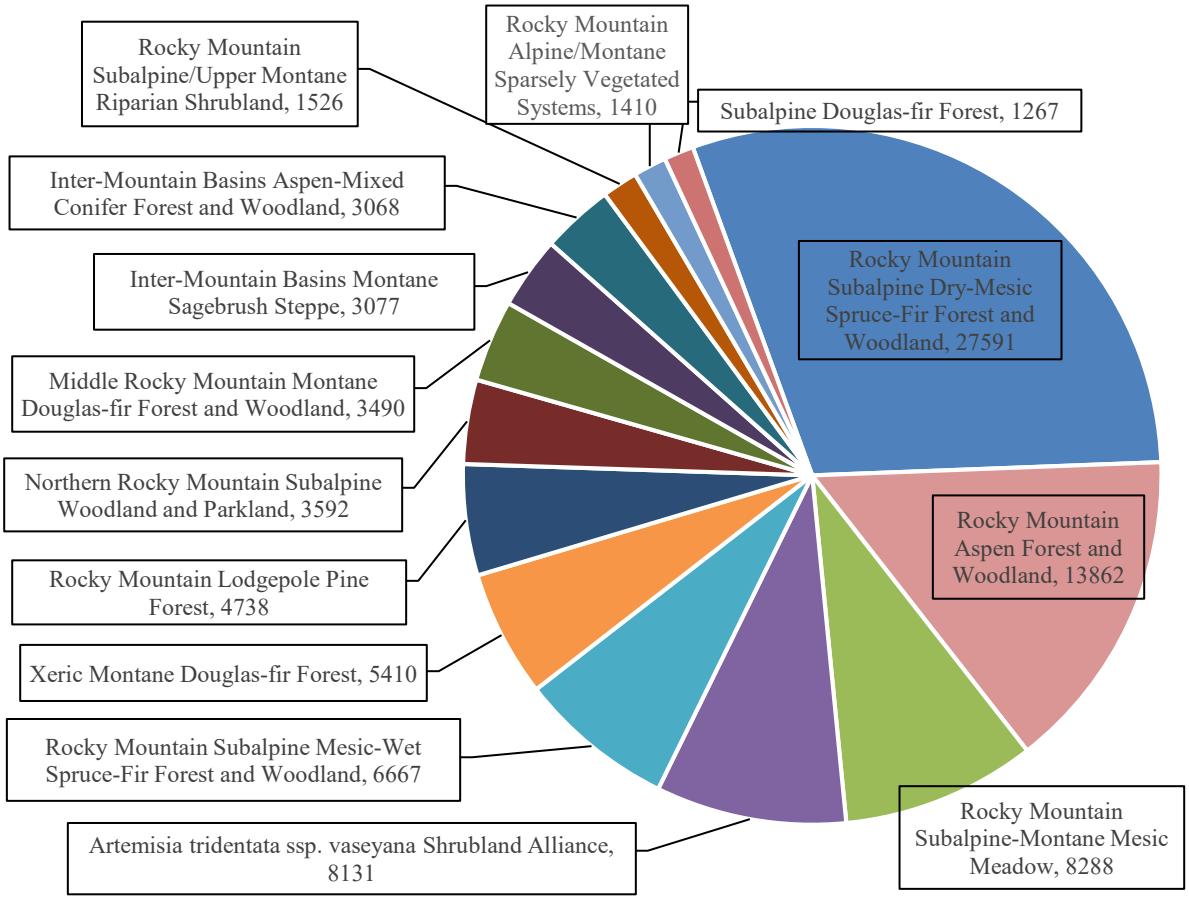

Figure 19. Acres burned by wildfire on BTNF, by biophysical setting type, 2015-2018

Discussion and findings

A variety of causes have led to an increase in wildfire acres during the past 20 years. An abundance of small trees and ladder fuels resulting from much of BTNF burning in the late 1800's produced favorable conditions for larger fires. In addition, fire management policy and moderate weather conditions from 1935-1985 allowed for widespread fire suppression and containment of unplanned ignitions to relatively small areas. Increasingly warmer and drier average conditions from 1985-2018, coupled with denser vegetation that was conducive to more rapid fire growth, have contributed to larger and more severe wildland fires.

The reason for the long-term decline in number of fires is not clear. It is likely that there are many small fires that are unreported. With so many acres burning across BTNF in the last 20 years, there are large areas of low fuel loading, where fires may not grow large enough to be detected. Another contributing factor may be the decreased use of low level aerial fire detection (i.e. flying planes for fire reconnaissance) following lightning activity. Many ignitions only burn a day or so before they self-extinguish and would not be recorded.

Another complexity in the discussion of wildland fires trends is how we categorize fires based on cause: human versus natural. Human-caused unplanned ignitions are considered unwanted in the current Forest Plan and are suppressed. Nonetheless, we cannot discredit the ecological role they have played on the landscape. The two large human-caused fires in 2018 (Roosevelt and Martin) together burned about 68,000 acres and have significantly changed the landscape. Since 1974, BTNF has progressively incorporated more management for resource benefit of naturally-occurring wildfire, rather than full suppression. From 1974-2004, fires were only managed in wilderness. The current Forest Plan was amended in 2004 to allow management for resource value of naturally ignited fires throughout the entire Forest. This new management direction is likely responsible for some of the increase in acres burned. To date, 44,000 acres have been managed for resource benefit since 2004.

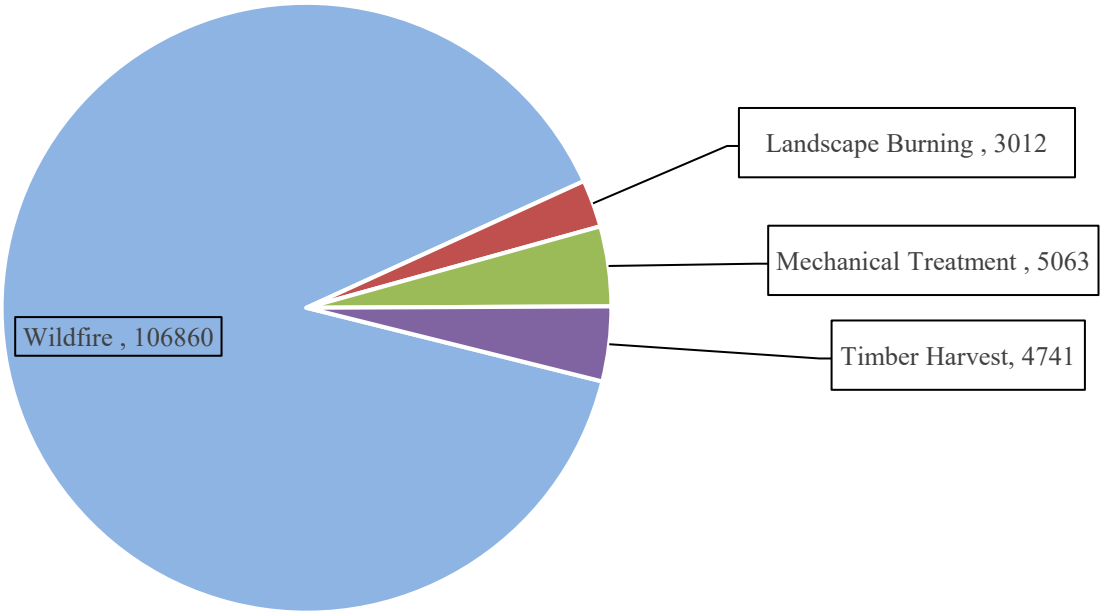

Figure 20. Total acres of disturbance by type, 2015-2018

Adaptive management considerations

Data analysis and results from this first monitoring period elucidated shortcomings in both indicator methodology and intent. In regards to methodology, the acres disturbed by fire are separated into those treated via prescribed burning and those impacted by unplanned ignitions. Plus, a review of existing data revealed no substantial acres impacted by landslides and floods. Based on the aggregation of wildfire as well as tree mortality data, it may not be useful—or even possible—to make the distinction between natural and anthropogenic processes. In general, the monitoring results that were available can provide basic status and trend information about how much of the landscape is impacted by wildfire but fail to fully address all the acres impacted by all natural processes.

In regards to intent, it is unclear how aggregating multiple natural processes addresses a specific Forest Plan objective or how the indicator would be used to guide management activities. It is unclear what actions BTNF would take if acres impacted by all aggregated natural processes—wildfire, tree mortality, landslides and floods—increased or decreased or if acres affected within a specific BPS increased or decreased. Similarly, there was no clear intent behind reporting the information in each BPS; this is not considered to be relevant to addressing the associated forest plan monitoring objective.

It is recommended that this indicator be revised to address solely wildfire, while tree mortality be addressed using the environmental stressor indicators and landslides and flooding be dropped. More directed change to management activities or the forest plan could be better addressed by tackling issues of wildfire and tree mortality separately. Furthermore, it may be beneficial to examine changes in vegetation successional class to address concerns on fire management, rather than BPS. Because the current indicator does not address the effects of climate change, which can directly affect the size and intensity of fires, as well as post fire vegetation development, some consideration should also be taken to how and if this can be included in a revised indicator.

Despite the short fallings of the current indicator to fully address all natural processes, the monitoring results related to wildfire suggest that 2004 forest plan amendment for fire management has increased flexibility for managers to appropriately manage wildland and prescribed fire. As such, no changes to the forest plan are warranted. The quantity of the landscape affected by wildfire is still below the historic range of variation. Whenever possible, additional opportunities to conduct managed fire should be explored to better meet the objectives of the forest plan.

Indicator VEG-01-03: Acres affected and/or susceptible to invasive plant species

Acres affected by invasive plants is addressed in Environmental Stressor Indicator EVS-01-03. Areas susceptible to invasive species was designed to include all forest management activities that may spread invasive plants (i.e. vegetation management, prescribed fire, and livestock grazing). However, attempts to collate data from existing data sources revealed that there was not readily available data to quantify how many acres are susceptible to invasive plants or how that would differ from the extent of acres as currently infested with invasive plants. Furthermore, the majority of BNTF is included in grazing allotments, so no meaningful trend in acres affected is likely to be detected. It is recommended that this indicator be dropped and invasive plant management be addressed via Environmental Stressors indicator EVS-01-03.

Question VEG-02: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of whitebark pine?

Indicator VEG-02-01: Acres treated for the purpose of sustaining or restoring whitebark pine (WBP)

Summary of methodology

One of the Forest Service's corporate databases—the Forest Activity and Tracking System (FACTS)—was queried for all treatments occurring in whitebark pine stands (WBP), including timber harvest, thinning, planting, prescribed fire, and mechanical fuel treatments for Fiscal Years FY15-FY18. FACTS is a part of the Forest Service's the Natural Resource Manager (NRM) system; information about these databases is available at http://fsweb.nrm.fs.fed.us/.

Monitoring Results

WBP restoration efforts on BTNF have primarily included the following activities: planting of seedlings to supplement natural regeneration; thinning/pruning to prevent spread of blister rust in five needle pines; release treatments to increase growing space (i.e. removal of non-target vegetation)(TABLE 6). Survival rates for planted seedlings ranges from 73-100%, but many have not yet been certified as successfully regenerated because the 5th year seedling survival surveys are not yet complete. All existing survey data for WBP planting projects indicate the stands are above the percent threshold for being considered fully regenerated at this time. The pruning project implemented FY18 to remove white pine blister rust infected limbs has not yet been surveyed and evaluated for success; post treatment surveys are forthcoming. Release treatments were surveyed post-treatment to indicate success of contract implementation. Continued post treatment monitoring of these stands is identified in FACTS.

Table 6. Summary of whitebark pine restoration treatments, FY15-FY18

Fiscal Year`	Plant Acres	Thin Acres	Release Acres
FY15	412		
FY16	78		188
FY17	87		
FY18		40	

Discussion and findings

At this time, the data that exists for WBP restoration treatments does not provide enough depth to indicate trends in treatment success or failure; however, the data does present a baseline in which future trends can be evaluated.

Although there are existing data on WBP restoration treatments, the data lack the depth to provide meaningful trends in the success or failure of treatment implementation. Based on the data available, WBP restoration treatments are being implemented successfully and are in alignment with the Forest plan direction for desired future conditions in these stands. Future monitoring for these projects is outlined in their respective silvicultural prescriptions and identified as a need where these projects are planned. Results of future monitoring for these projects is forthcoming and will be reported in future biannual monitoring reports.

Adaptive Management Considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Indicator VEG-02-02: Acres by forest size class for whitebark pine

Summary of methodology

BTNF Existing Vegetation dataset was utilized to quantify acres by forest size class for whitebark pine (WBP). In this regionally produced dataset, vegetation map types were characterized by map unit (dominant land cover), tree and shrub canopy cover class, and tree size class, using a field-based classification system and field keys, cross-walking existing vegetation information, and developing descriptions for the map units. The dataset was updated in 2018 using the Vegetation Classification, Mapping, and Quantitative (VCMQ) inventory data. However, the 2018 dataset does not currently reflect vegetation changes from the Martin Fire or the Roosevelt Fire which occurred in 2018. In terms of forest type, 'WBP' and 'WBP mix' are described in the WBP Range-Wide Restoration Strategy (Keane and others 2012). 'WBP' includes the higher elevation climax WBP sites that exist on harsher upper subalpine forests and at tree line on relatively dry, cold slopes; other species, such as subalpine fir, spruce, and lodgepole pine, can occur on these sites but as scattered individuals. Conversely, 'WBP mix' includes WBP seral sites that exist on productive upper subalpine sites where may be replaced by the more shade-tolerant subalpine fir and/or Engelmann spruce

Monitoring Results

Table 7. Acres of whitebark pine by forest size class, 2012 & 2018

Forest Type, Year	Size 2 (<5" dbh)	Size 3 (5 – 9.9" dbh)	Size 4 (10-19.9" dbh)	Size 5 (20-29.9" dbh)	Size 6 (30"+ dbh)	Total
2012	12,111	124,566	262,620	6,182	393	405,873
WBP	7,934	64,392	125,667	4,728	318	203,039
WBP, mixed	4,177	60,174	136,953	1,455	74	202,834
2018	12,108	124,377	262,336	6,182	393	405,397
WBP	7,936	64,267	125,514	4,728	318	202,763
WBP, mixed	4,173	60,110	136,822	1,455	75	202,634

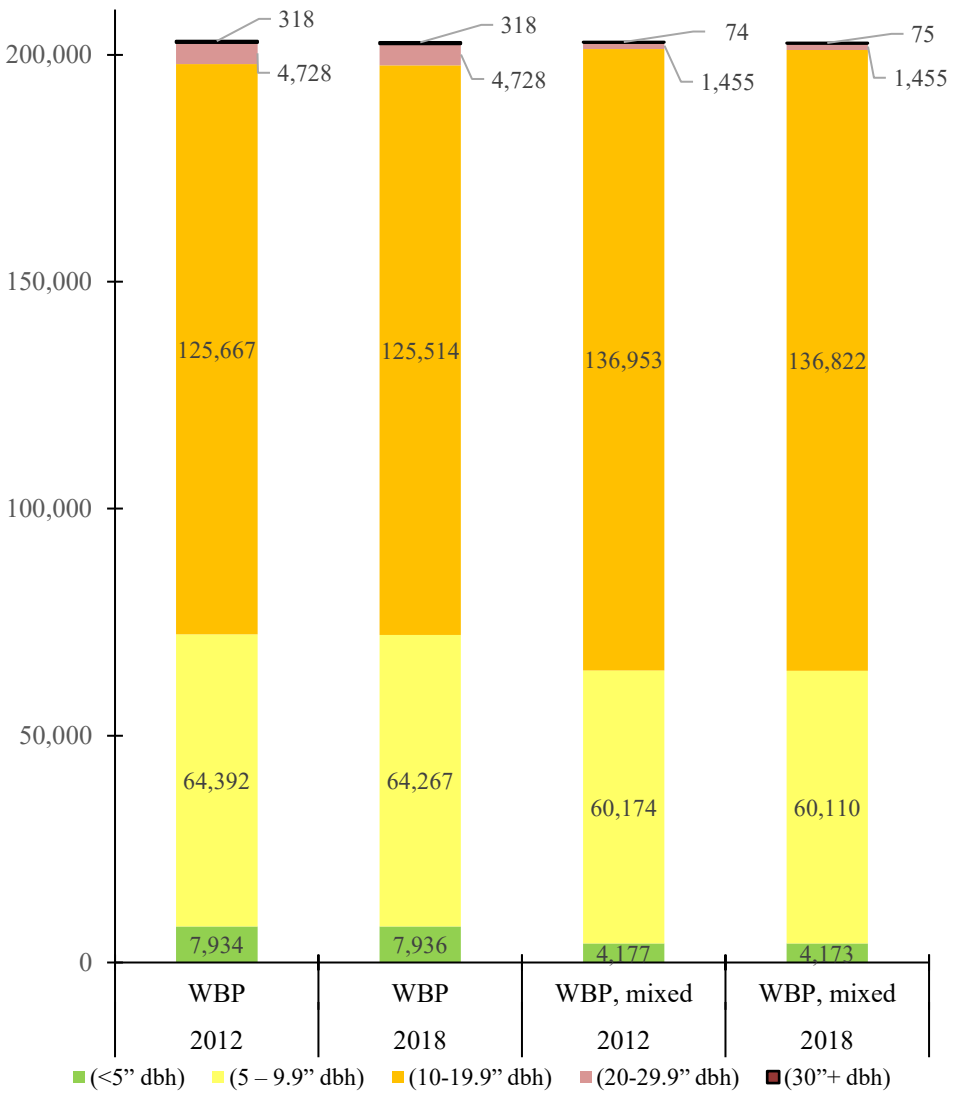

Figure 21. Comparison of acres of whitebark pine by forest size class, 2012 & 2018

Discussion and findings

There has not been substantial change in WBP size classes between 2012 and 2018. In 2018, there is a slight decrease in acres (475 ac) in forest size class three (5-9.9" dbh) and four (10-19.9" dbh). This loss is likely due to mortality cause by wildfire and by white pine blister rust and pine beetle infestations. Burn severity was high enough to transition WBP forest type to a grass/forb vegetation type. Remapping of vegetation to include the Roosevelt and Martin fires from 2018 may show a shift to smaller size classes or a transition to difference vegetation types. This will be interpreted in the next biannual monitoring report.

Adaptive Management Considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Question ARE-01: Are native aquatic and riparian ecosystems maintaining or improving in relation to aquatic invasive/exotic species?

Indicator ARE-01-01: Miles of stream and acres of lake habitats that have aquatic invasive/ exotic species present

Summary of methodology

Presence / absence data of dreissenid mussels and New Zealand mud snail—two aquatic invasive species that threaten ecosystem function on BTNF—were collected using environmental DNA (eDNA) method protocols, which capture DNA expelled from these organisms in waterbodies. Sampling was limited to larger lakes where motorized boating is allowed because these areas are likely at greatest risk of infestation due to the presence of vectors for spread (i.e. boats coming from infested waters). Ten lakes were sampled by FS at launch ramps, inlets, outlets, docks, and any recreation site where hand launching of watercraft appeared probable.

Monitoring results

At the ten lakes sampled in 2017, no eDNA of the monitored species were detected. Samples collected in 2018 have yet to be analyzed.

Discussion and findings

Failure to detect dreissenids and mud snail in large lakes where motorized boating occurs using the relatively sensitive method of eDNA analysis indicates that that these waters, and upstream waters, have a low probability of current infestations. However, there has been detection of aquatic invasive species downstream of BTNF in the Snake River Drainage and detection of New Zealand mud snails in the Salt River at the confluence of the Snake River immediately downstream of the Greys River Ranger District. These recently discovered infestations could be inadvertently spread onto BTNF by recreational watercraft. Additional monitoring is planned for 2019 with the goal of limiting the spread of recently detected New Zealand mud snails.

The current monitoring effort is the first attempt by BTNF to monitor for aquatic invasive species. It was limited to dreissenids and mud snails. Analysis of samples for other species (including non-native fish) is being considered for subsequent monitoring periods.

Adaptive management consideration

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities is warranted.

Indicator ARE-01-02: Miles of stream and acres of lake habitats in which aquatic invasive/ exotic species have displaced native aquatic species

Summary of methodology

The magnitude of native aquatic species displacement by aquatic-invasive/ exotic species is determined by calculating the current invasion extent and adding the predicted rate of spread before anticipated treatments. It is assumed that the area of habitat occupied by invasive species is equal to the area in which native species have been displaced. Results are to be used to estimate the cost of treatment alternatives.

Monitoring results

This indicator was not monitored in 2017-2018.

Discussion and findings

This monitoring was not conducted because there is no indication that target aquatic invasive species are currently present in BTNF lakes. As such, BTNF is meeting the Forest Plan objective to manage aquatic invasive species. If priority AIS are discovered in the future, then monitoring should be initiated.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan, or management activities are warranted.

Question FOC-01: Are forest management activities and/or natural events affecting aquatic conditions indicated by the presence/absence of a focal species?

Indicator FOC-01-01: Change in known distribution of native cutthroat species

Indicator FOC-01-02: Change in relative abundance of native cutthroat species meta-populations as determined through monitoring surveys.

Summary of methodology

Changes in known cutthroat trout distribution are quantified by electrofishing surveys collected by Wyoming Game and Fish Department and BTNF aquatics staff. In 2018, Cutthroat Trout electrofishing surveys were conducted at 25 sites by BTNF aquatics staff.

New science or information

Aquatic organism passage (AOP) surveys and qualitative observations all conducted by BTNF aquatics staff were also included. These surveys review road-stream crossings for passage by cutthroat trout species. Fourteen AOP surveys were conducted in 2018 in the Tri-Basin area of the Upper Greys River, Monument Ridge project area and Salt Creek project area.

Monitoring results

For the 25 stream reaches that were surveyed in 2018, presence of cutthroat trout was confirmed at 15 sites. Electrofishing surveys during the 2018 field season had low total capture efficiency for Cutthroat Trout. Twenty-six Cutthroat Trout were observed in the Tri-Basin (Greys-Hoback River drainage), 21 in Salt Creek (Bear River drainage), and two in the Monument Ridge (Greys-Hoback River drainage) project areas. The remaining Cutthroat Trout individuals were sampled in the Upper Green River drainage and Snake River headwaters drainage, at sites that were specifically established for focal species monitoring. Two Brook Trout were observed during the entire field season, one each at North Fork Spread Creek (Snake River Watershed) and Lead Creek (Green River Watershed). Although not a focal species, abundant Mottled Sculpin and Paiute Sculpin were observed forest wide, suggesting that sampling equipment and methodology was functioning properly.

In the 2018 AOP surveys, there were seven road-stream crossings that were impassable for juvenile Cutthroat Trout. Three culverts were surveyed in the Monument Ridge project area, but more data are

needed for determination of AOP barriers. In the Salt Creek project area, three culverts were assessed, two of which were barriers to all life stages of Cutthroat Trout.

Discussion and findings

Low capture totals may be the result of low stream water electrical conductivity (15-30 µS), low relative abundance, inconsistencies in sampling methods and small fish size which have a lower capture probability than larger fish. Catch numbers per unit of effort were lowest in the Salt Creek project area. Within the Salt Creek project area, surveys were completed to target fish presence/absence below and above potential passage barriers and were not in optimum habitat. Wyoming Game and Fish Department monitoring in the 2010s showed that Cutthroat Trout were present in the area. Establishing additional monitoring sites in subsequent field seasons would likely increase the probably of detecting trends in Cutthroat Trout abundance and distribution.

Monitoring efforts for cutthroat trout on BTNF were initiated in 2018. Given the spatial and temporal limitations of monitoring as well as low catch rates, conclusions about fish abundance are likely still years away. In order to draw more meaningful conclusions about Cutthroat Trout status and trends, additional staff capacity and funding are needed to perform additional monitoring for focal species. Until additional spatial and temporal data are collected, determination of the cause of 2018's low catch totals remains inconclusive and no conclusions about abundance can be drawn.

Similarly, based upon the current monitoring results, it is difficult to draw conclusions regarding the distribution or ecological condition for cutthroat trout, and subsequently whether Forest Plan objectives are being met. The current monitoring indicators do not directly address ecological condition (e.g. habitat condition, barriers to passage). Without conclusive information, currently there is no basis to consider changing the forest plan or management activities at this time. When more field work is completed in 2019-2020, it may be possible to better describe the distribution of Cutthroat Trout and evaluate the effectiveness of opening fish habitat through the removal of aquatic organism passage barriers.

Adaptive management considerations

Based upon the monitoring results, no changes to the Forest Plan or management activities are warranted. Currently BTNF lacks staff capacity and funding to conduct necessary monitoring to assess relative abundance. Without additional funding, it will continue to be challenging to assess trends and whether or not forest plan objectives are met. Furthermore, the existing indicators may not be sufficient to adequately characterize whether forest management activities and/or natural events are affecting aquatic conditions indicated by the presence/absence of a focal species. It is recommended that future monitoring periods continue to incorporate aquatic organism passage surveys to describe ecological condition.

Question WDL-01: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the endangered Kendall Warm Springs dace?

Indicator WDL-01-01: Replicate relative abundance estimates

Indicator WDL-01-02: Number and type of habitat improvement projects

Indicator WDL-01-03: Channel width to depth ratios (including vegetation encroachment) using 1995 research as baseline

Indicators WDL-01-04: Channel Temperature and Water Quality/Chemistry using 1978 report as baseline

Summary of methodology

Monitoring of Kendall Warm Springs Dace on BTNF relies primarily on Forest Service biennial relative abundance sampling and temperature monitoring, with support from Wyoming Game and Fish Department (WGFD) on habitat surveys, and US Geological Survey (USGS) on water quality. Kendall Warm Springs Dace populations are sampled biennially using a protocol for relative abundance estimates developed in the mid-1990s. Habitat improvement projects are tracked in a Forest Service corporate database. Quantitative and qualitative habitat analyses (e.g. functional vegetation type, channel width/depth ratios) were initiated on BTNF in 2018. Water quality is sampled annually and temperature loggers have periodically been deployed. Water chemistry has only been sampled periodically in dedicated studies to compare to periodic historic data collection efforts.

Monitoring results

Relative abundance data from 1997-2017 suggest decline in observed relative abundance (FIGURE 22). In 2018, although a comprehensive investigation was not completed, capture efforts using the same method over just one cycle showed similarly low catch per sampling event values. No habitat improvements, besides minor repairs to the ungulate exclosure fence, occurred in 2017-2018. Habitat analysis was initiated in summer of 2018, but there are no results to report.

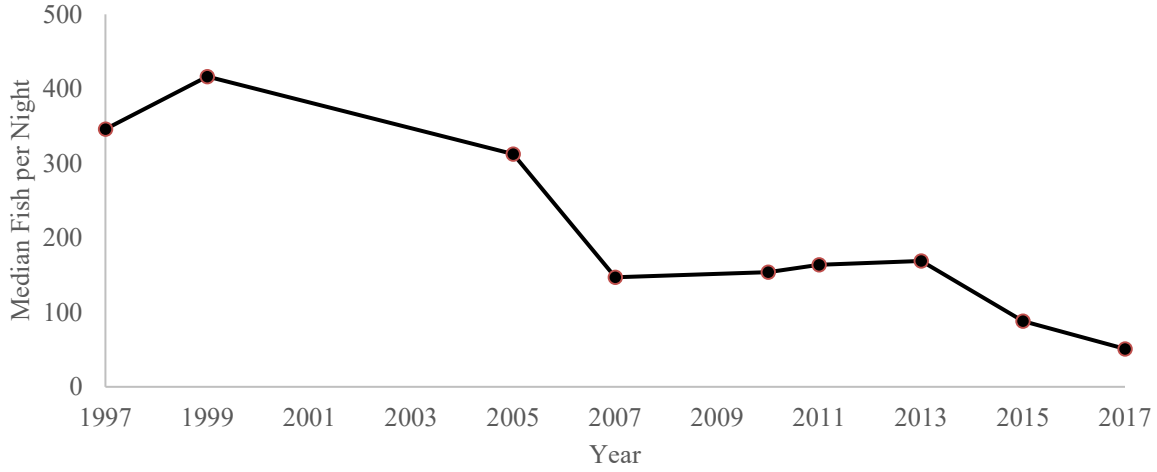

Figure 22. Relative Abundance of Kendall Warm Springs Dace by Median Number of Fish Captured per Night, 1997-2017

Discussion and findings

Since the inception of the relative abundance monitoring protocol in the mid-1990s, there has been an apparent decline in the relative abundance estimates of Kendall Warm Springs Dace (FIGURE 22). Data from 2017-2018 align with the downward trend. Habitat analysis was initiated in summer of 2018, but at this time no conclusions can be drawn. Likewise, no conclusions about long term water temperature trends can be drawn from recent efforts to collect water temperature data. Currently, there doesn't seem to be significant differences between historic point-in-time temperature data and general stream temperatures within Kendall Warm Springs, but more data are needed. In 2017, USGS completed a water chemistry analysis showing only minimal differences between historic and modern stream chemistry; however, the study did not offer an interpretation of the data. Unfortunately, the existing datasets are probably too narrow and short-term to assess a trend for the species.

Kendall Warm Springs Dace resides solely in a warm spring tributary to the Green River within BTNF; the thermal spring creek is less than 1,000 feet long (US Fish and Wildlife Service 2015). Despite the very limited distribution, BTNF has undertaken many management actions to improve and conserve habitat for the species in accordance with the recovery plan (US Fish and Wildlife Service 2015), including designation of the KWS special interest area, fencing, bridge replacement along the creek and a swimming/bathing moratorium. As such, BNTF is actively engaging in management that should increase species abundance and meet the objectives of the forest plan for Kendall Warm Springs Dace.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Question WDL-02: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the threatened Greater Yellowstone Area (GYA) grizzly bear?

Indicator WDL-02-01: Change from the 1998 baseline in secure habitat and motorized route density inside the Primary Conservation Area (PCA).

Indicator WDL-02-02: Change from the 1998 baseline in developed sites inside the PCA.

Indicator WDL-02-03: Change from the 1998 baseline in the number and acreage of commercial livestock grazing allotments and the number of sheep animal months inside the PCA.

Indicator WDL-02-04: Change from the 2008 baseline in secure habitat outside the PCA.

Summary of methodology

Grizzly Bear monitoring in the Greater Yellowstone Area is conducted collaboratively by the Interagency Grizzly Bear Strategy Study Team (IGBST). The monitoring information included below

is also a part of their annual report available publically at: https://www.usgs.gov/centers/norock/science/igbst-annual-reports.

Habitat standards are identified in the 2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem and pertain to secure habitat, developed sites, and livestock grazing allotments (Interagency Grizzly Bear Committee 2016). The standards demand that all three of these habitat parameters are to be maintained at or improved upon conditions that existed in 1998. The 1998 baseline represents the best estimate of what was known to be on the ground inside the Primary Conservation Area (PCA) in 1998 and establishes a benchmark against which future improvements and/or impacts can be assessed. Metrics and analysis of each indicator is described in detail in Appendix E of the Conservation Strategy.

For indicator WDL-02-01, motorized access parameters that are monitored and reported include levels of secure habitat; open motorized access route density (OMARD) greater than 1.6 km/2.6 sq. km (1 mi/sq. mi) and total motorized access route density (TMARD) greater than 3.2 km/2.6 sq. km (2 mi/sq. mi). These are calculated using the Motorized Access Model as described in Appendix E of the Conservation Strategy. Inside the PCA, these three parameters are measured and reported annually for each bear management subunit.

For indicator WDL-02-02, developed sites include all sites on public land developed or improved for human use or resource development. Changes in developed sites on BTNF inside the PCA are measured, tracked, and evaluated against 1998 levels. For indicator WDL-02-03, on federal lands inside the PCA, the number and acreage of commercial livestock grazing allotments and the number of sheep animal months (AMs) is monitored and reported annually relative to 1998 levels.

For indicator WDL-02-04, changes in secure habitat outside the PCA in areas deemed to be biologically suitable and sociably acceptable for grizzly bear occupancy are also reported to IGBST biennially. Although habitat standards apply only inside the PCA, the percent secure habitat outside this boundary is reported on even years per Bear Analysis Unit (BAU) against the 2008 baseline. There are five BAU on BTNF that fall within this category: Fremont, Green River, Gros Ventre, Hoback Range, and Snake River.

Monitoring results

Table 8. Percent per subunit of open motorized access route density (OMARD), total motorized access route density (TMARD), and secure habitat for the six Bear Management Unit subunits located in the PCA on BTNF, 1998 & 2017

BMU Subunit Name	% OMARD (> 1 mi / mi^2)			% TMARD (> 2 mi / mi^2)			% Secure Habitat			Area (miles^2) (excluding lakes)		
										Sub Unit	Secure Habitat	
	1998	2017	% chg	1998	2017	% chg	1998	2017	% chg		1998	2017
Buffalo/Spread Creek #1	11.5	11.4	-0.1	5.3	6.1	0.8	88.3	88.6	0.4	219.9	194.1	194.9
Buffalo/Spread Creek #2	15.6	16.0	0.5	12.7	9.2	-3.5	74.3	74.4	0.1	507.6	377.2	377.5
Thorofare #1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	273.4	273.4	273.4
Thorofare #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	180.1	180.1	180.1
Two Ocean #1	3.5	3.6	0.2	0.3	0.5	0.2	96.3	96.3	0.0	371.9	358.3	358.2
Two Ocean #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	124.9	124.9	124.9
Mean for PCA & Total sq. miles	**5.1**	**5.2**	**0.1**	**3.1**	**2.6**	**-0.4**	**93.2**	**93.2**	**0.1**	**1677.8**	**1508.0**	**1509.0**

Table 9. Developed sites for the six Bear Management Unit subunits located in the PCA on BTNF, 1998 & 2017.

BMU Subunit Name	Summer Home Comp.		Developed Camp.		Trailheads		Maj. Dev. Sites and Lodges		Admin. or Maint. Sites		Other Developed Sites		Plans of Oper. for Minerals		Total Number of Sites	
	1998	2017	1998	2017	1998	2017	1998	2017	1998	2017	1998	2017	1998	2017	1998	2017
Buffalo/Spread Creek #1	0	0	1	1	1	1	0	0	0	0	2	2	0	0	4	4
Buffalo/Spread Creek #2	1	1	4	2	3	5	3	3	5	5	5	3	1	1	22	20
Thorofare #1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thorofare #2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2
Two Ocean #1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1
Two Ocean #2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2
Total in PCA	**1**	**1**	**6**	**4**	**4**	**6**	**3**	**3**	**9**	**9**	**7**	**5**	**1**	**1**	**31**	**29**

Table 10. Commercial livestock grazing allotments and sheep animal months inside the PCA on BTNF, 1998 & 2017.

Cattle/Horse Allotments				Sheep Allotments				Sheep Animal Months	
Active		Vacant		Active		Vacant			
1998	2017	1998	2017	1998	2017	1998	2017	1998	2017
9	6	0	1	0	0	0	0	0	0

In 2017, there was one reported change in livestock grazing allotments inside the PCA. A small parcel of privately owned cattle/horse pasture land was newly acquired by BTNF. The 28-acre parcel adjoins the Hatchet Resort to the east and US Highway 26/287 to the north. Prior to 2017, under the Jackson Hole Land Trust ownership, the parcel was grazed extensively. In 2017, BTNF issued a temporary special use permit for summer cattle grazing. Situated at the base of Togwotee Pass, this relatively undisturbed pasture has no prior history of livestock-grizzly bear interactions. Until an environmental assessment can be conducted, the long-term grazing status of the parcel is undetermined.

Table 11. Percent secure habitat in BAUs outside the PCA on BTNF, 2008 & 2016

Bear Analysis Unit (BAU)	Percent Secure Habitat				BAU Area[a] (Miles^2)
	2008 (Baseline)	2014	2016	Change (2008-2016)	
Fremont	88.0	88.2	88.2	0.2	440.0
Green River	65.7	65.7	65.7	0.0	527.9
Gros Ventre	63.7	63.9	63.9	0.2	507.7
Hoback Range	58.9	58.9	58.9	0.0	292.9
Snake River	64.0	64.2	64.2	0.2	348.9
Mean Secure or Total sq. miles	**68.1**	**68.2**	**68.2**	**0.1**	**2117.4**

[a]Lakes greater than 1 mi^2 are excluded from secure habitat calculations and from total BAU area counts.

Discussion and findings

A 2006 Forest Plan amendment requires the monitoring and reporting of changes of Grizzly Bear secure habitat both in the PCA (annually) and outside the PCA in BAU (biannually). BTNF continues to meet the monitoring and reporting requirements. The 2006 amendment also requires that BTNF meet or exceed the habitat standards set within the PCA and outside the PCA in BAU. Currently, on BTNF, all habitat standards within the PCA and outside the PCA meet the respective baseline.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Question WDL-03: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the threatened Canada lynx and its critical habitat?

Indicator WDL-03-01: Acres of fuel treatments and vegetation projects reported in accordance with the required monitoring found in the Northern Rockies Lynx Management Direction

Summary of methodology

The intent of this indicator is to track management activities involving the exemptions for treating hazardous fuels within the WUI and pre-commercial thinning in lynx habitat on BTNF, per the US Fish and Wildlife Service's (USFWS) Biological Opinion for the Northern Rockies Lynx Management Direction (NRLMD). The exemptions are codified as vegetation management standards VEG S1, S2, S5 and S6. BTNF allocation per USFWS incidental take statement is as follows: VEG S5: 1,000 acres for whitebark pine restoration; VEG S1, S2, S5, and S6: 120,000 acres for hazardous fuels treatments within the WUI. To track management activities, once the decision document is signed for a project that may impact lynx habitat, the tables for exemptions are updated to ensure the thresholds are not exceeded. Any deviations to the guidelines requires a rationale; these are tracked and reported to USFWS. A full description of the analysis criteria is included in BTNF monitoring guide.

Monitoring results

Table 12. Use of the NRLMD exceptions to Standard VEG S5 (Pre-commercial Thinning), 2007-2017

Forest	Project Name	Decision Date (Month/Year)	Project Location (LAU)	Categories of Pre-Commercial Thinning (PCT) Exceptions												Total Allocated (Acres)	Total Treated (Acres)		VEG S1 Met?
				Research		Genetic Testing		Administrative		White Pine		Whitebark Pine		ASPEN					
				Allowed	Treated	Allowed	Treated	Allowed	Treated	Allowed	Treated	Allowed	Treated	Allowed	Treated		Overall	Critical Habitat	
BRIDGER-TETON	Buffalo Valley Fuels Mgmt.	4/8/2010	Buffalo Fork West		0		0		0		0		17		0		17	17	Yes
	Grouse Mtn. Whitebark pine Restoration	5/6/2012	Spread Creek East		0		0		0		0		53		0		53	53	Yes
			Total Acres	0	0	0	0	0	0	0	0	1,000	70	0	0	1,000	70	70	

Table 13. Incidental Take summary for the use of exemptions and exceptions under the NRLMD, 2007-2017

Summary of ALL vegetation projects in lynx habitat and use of the Fuels Treatment Exemptions in lynx habitat within the WUI, June 2007 - December 2017.										
Forest	Acres of Lynx Habitat Treated		Acres of Lynx Habitat Treated Outside WUI		Acres of Lynx Habitat Treated w/in WUI		Acres of Lynx Habitat in WUI Where Exceptions to Standard(s) are Applied		Forest Allocation per Incidental Take	Current Forest Balance (acres)
	Total	Critical Habitat	Total	Critical Habitat	Total	Critical Habitat	Total	Critical Habitat		
Bridger-Teton	25,790	32,449	7,160	18,252	18,630	14,197	17,034	13,811	120,000	**102,966**

Table 14. Summary of all vegetation treatments in Lynx habitat, the use of NRLMD exemptions in WUI, exceptions to VEG S6 for treatment around administrative sites, for research sites and incidental removal during salvage operations, and rationale for deviating from any of the vegetation guidelines.

Project Name	Decision Date (Month & Year)	Project Location (LAU)	Acres of Habitat Treated			Acres of Habitat Treated Outside of WUI			Acres of Habitat Treated within WUI			Acres of Lynx Habitat Treated in WUI Where the 6% Cap Applies		Standard(s) Exempted for Treatment in the WUI	Rationale for applying Exemptions to Vegetation Standard(s)	Do any 2 Adjacent LAUs Exceed Standard VEG S1	Acres of Lynx Habitat Treated Where Exception to Veg S6 Applied		Justification for applying exception to *Vegetation S6* (admin. site, research, or incidental removal for salvage)	Rationale for deviating from any of the Vegetation Guidelines (i.e. G1, G4, G5, G10, G11).
			Mapped Lynx Habitat	Critical Habitat	Matrix	Mapped Lynx Habitat	Critical Habitat	Matrix	Mapped Lynx Habitat	Critical Habitat	Matrix	Mapped Lynx Habitat	Critical Habitat				Mapped Lynx Habitat	Critical Habitat		
Bryan Flats Fuels Reduction	Sep-08	Lower Hoback Middle	1201	2349	1148	528	1204	676	673	1145	472	673	1,145	S6	Fuels w/in WUI	No	0	0	NA	NA
Red Cliff Addition	Dec-09	Big Twin West, Big Twin East	463	1043	580	0	0	0	463	1043	580	463	1043	S6	Fuels w/in WUI	No	0	0	NA	NA
Hoback Jct Fuels Reduction	Mar-10	Fall Creek North, Fall Creek South, Lower Hoback Middle	2680	3682	1002	0	0	0	2680	3682	1002	1470	3,682	S6	Fuels w/in WUI	No	0	0	NA	NA
Pole Creek Prescribed Burn & East Fork Salvage	Apr-10	Hams Fork	4010	6550	2540	250	250	0	3,760	6,300	2540	3,760	6,300	S6	Fuels w/in WUI	No	0	0	NA	NA
Buffalo Fuels Management	Apr-10	Buffalo Fork West, Buffalo Fork Middle	718	1727	1009	72	86	14	646	1641	995	646	1,641	S6	Fuels w/in WUI	No	0	0	NA	NA
Grouse Mtn. Whitebark pine Restoration	May-12	Spread Creek East	53	639	586	53	639	586	0	0	0	0	0	none	NA	No	53	53	Research	NA
Hams Fork Vegetation Treatment	Sep-13	Hams Fork	1,780	8,682	6,902	1,445	8,347	6,902	335	335	0	0	0	none	NA	No	177	177	Incidental removal during salvage	NA
LaBarge Veg. Restoration	Dec-15	LaBarge Creek	4,802	7,716	2,914	4,802	7,716	2,914	0	0	0	0	0	none	NA	Yes	0	0	NA	NA
Skyline Fuels Reduction	Sep-16	Pine creek, Pole Creek	2,247	0	0	0	0	0	2,247	0	0	2,247	0	S6	Fuels w/in WUI	Yes	0	0	NA	NA
Teton-to-Snake	Sep-17	Fall Creek North, Fall Creek South	7,775	0	3,002	0	0	0	7,775	0	3,002	7,775	0	S6	Fuels w/in WUI	No	0	0	NA	NA
North Piney Post and Pole Commercial Thinning Project	Jan-18	South Beaver	61	61	0	10	10	0	51	51	0	0	0	none	NA	No	0	0	NA	NA
		Total Acres Treated	25,790	32,449	19,683	7,160	18,252	11,092	18,630	14,197	8,591	17,034	13,811				230	230		

Discussion and findings

In 2017 and 2018, no acres of pre-commercial thinning in lynx habitat were conducted (TABLE 12). In 2017, 7775 ac of vegetation treatments in WUI were utilized as part of the Teton-To-Snake Project (TABLE 14). With the exemptions granted for vegetation management standards VEG S1, S2, S5 and S6 on the NRLMD Incidental Take Statement, BNTF still has over 102,000 acres available to utilize for WUI fuels treatments and 970 acres for whitebark pine restoration (TABLE 13). BTNF is in compliance with the NRLMD Incidental Take Statement and therefore meeting the objectives of the Forest Plan in regards to lynx habitat.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Indicator WDL-03-02: Changes in lynx habitat as a result of moving towards the desired conditions for vegetation through vegetation management, prescribed fire, or natural disturbance.

Summary of methodology

This indicator will be used to determine changes in the amount of lynx habitat within each Lynx Analysis Unit (LAU) that is in an early stand initiation stage (i.e. from natural events, vegetation/fuels treatments, or any combination of these or other causes) and therefore unsuitable as winter snowshoe hare habitat. This is updated annually with timber management activities from fire history GIS data and FACTS. FACTS is a part of the Forest Service's NRM corporate databases.

Monitoring results

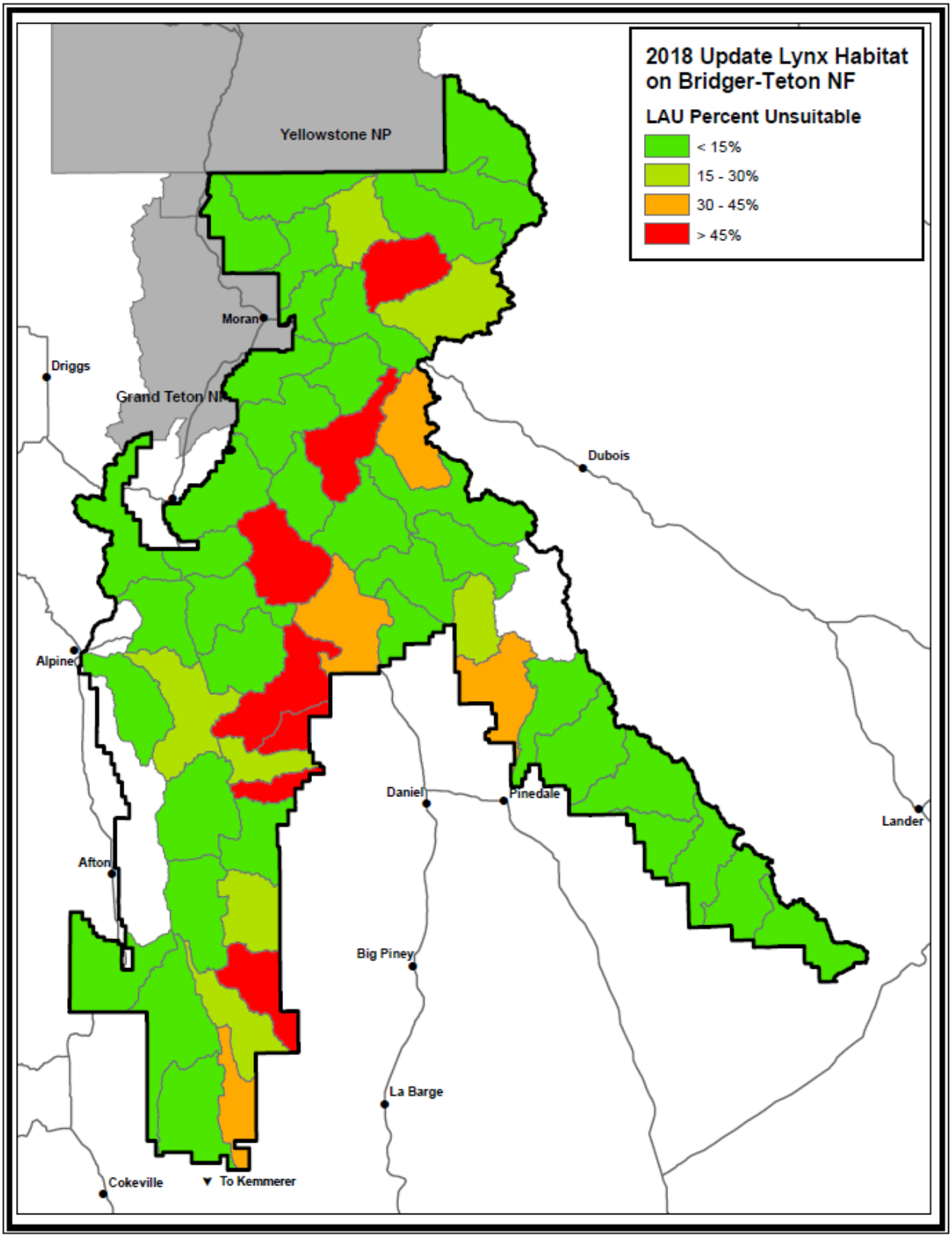

Figure 23. Percent unsuitable habitat for each Lynx Analysis Unit on BTNF, 2018

Discussion and findings

Large fires continue to be the main driver in turning suitable lynx habitat into unsuitable habitat. The Roosevelt Fire in 2018 was instrumental in changing the overall suitability of two LAU's from <15% unsuitable to >45% unsuitable (FIGURE 23). However, areas affected by the large fires of 1988, mainly on the Blackrock Ranger District just south of Yellowstone National Park, were recalibrated from unsuitable habitat to suitable in 2018 due to increased canopy cover resulting from 30 years of post-fire tree growth. Approximately 30 years of tree growth post-disturbance is considered adequate to reestablish continuous cover and provide winter snowshoe hare habitat.

BNTF continues to update lynx habitat annually, which is utilized for applying vegetation management standards during project development and review. As such, BTNF continues to meet the objectives of the forest plan in terms of lynx habitat management.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

New science or information: surveys and incidental sightings

Summary of methodology

A collaborative effort between the Bridger-Teton and Shoshone National Forests, Grand Teton National Park, the Forest Service National Carnivore Program, and the Rocky Mountain Research Station, and the National Genomics Center for Wildlife and Fish Conservation was initiated in 2015 to provide the most current understanding of mesocarnivore presence and distribution across components of BTNF, Shoshone NF and Grand Teton NP. From 2015-2017, the project used snow-track surveys, remote cameras, hair snares, scent lure, carrion baits, and molecular-based methods to document the presence of mesocarnivores at detection stations and along survey (snow-tracking) routes located within 8 x 8 km grid cells in prime lynx habitat (FIGURE 24). In combination with historic detection data, this project has directly informed an ongoing, less- intensive but long-term mesocarnivore detection effort sourced out of the Rocky Mountain Research Station and conducted on BTNF in 2018.

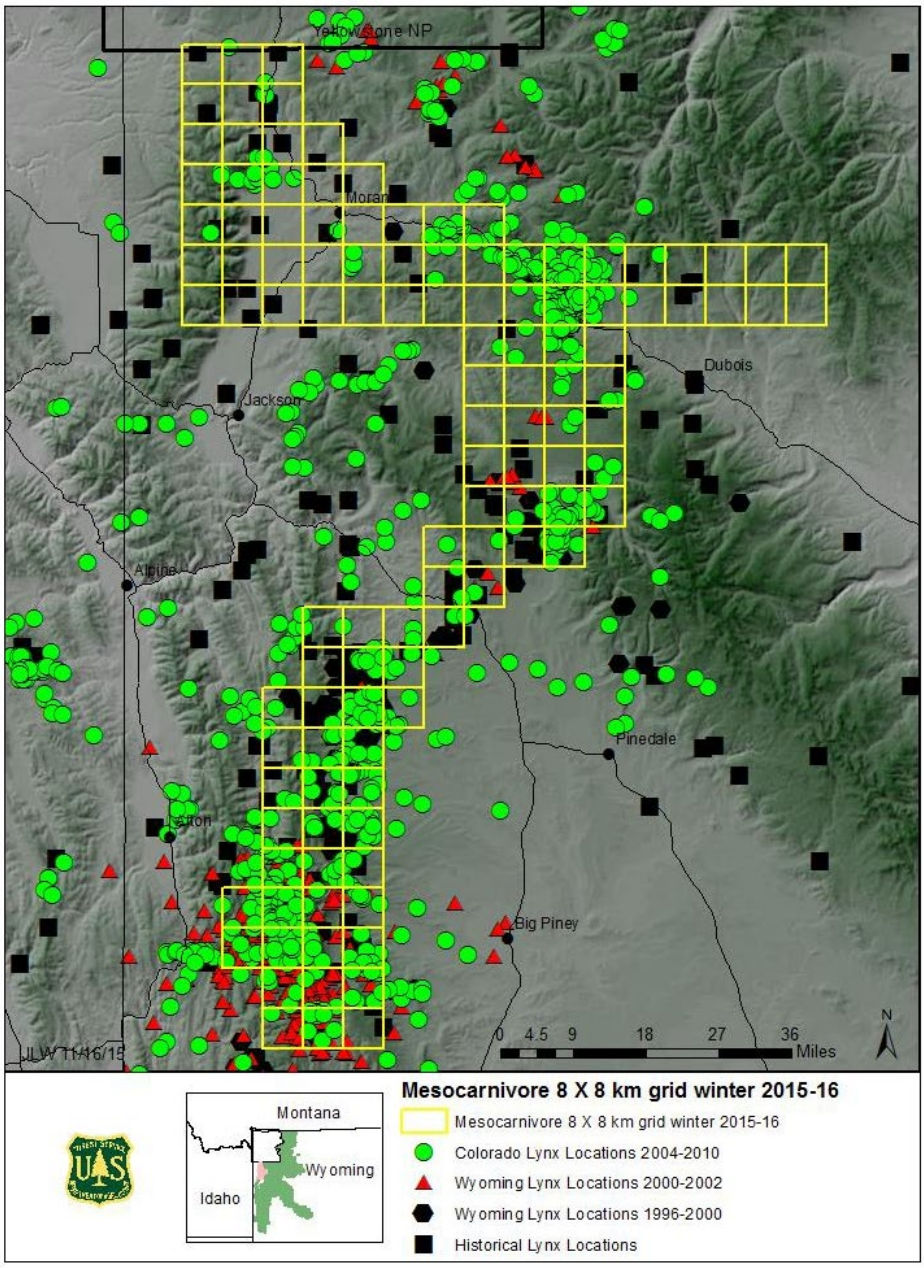

Figure 24. Historic lynx detections and survey grid for 2015-2016 south Yellowstone are mesocarnivore monitoring

Monitoring results

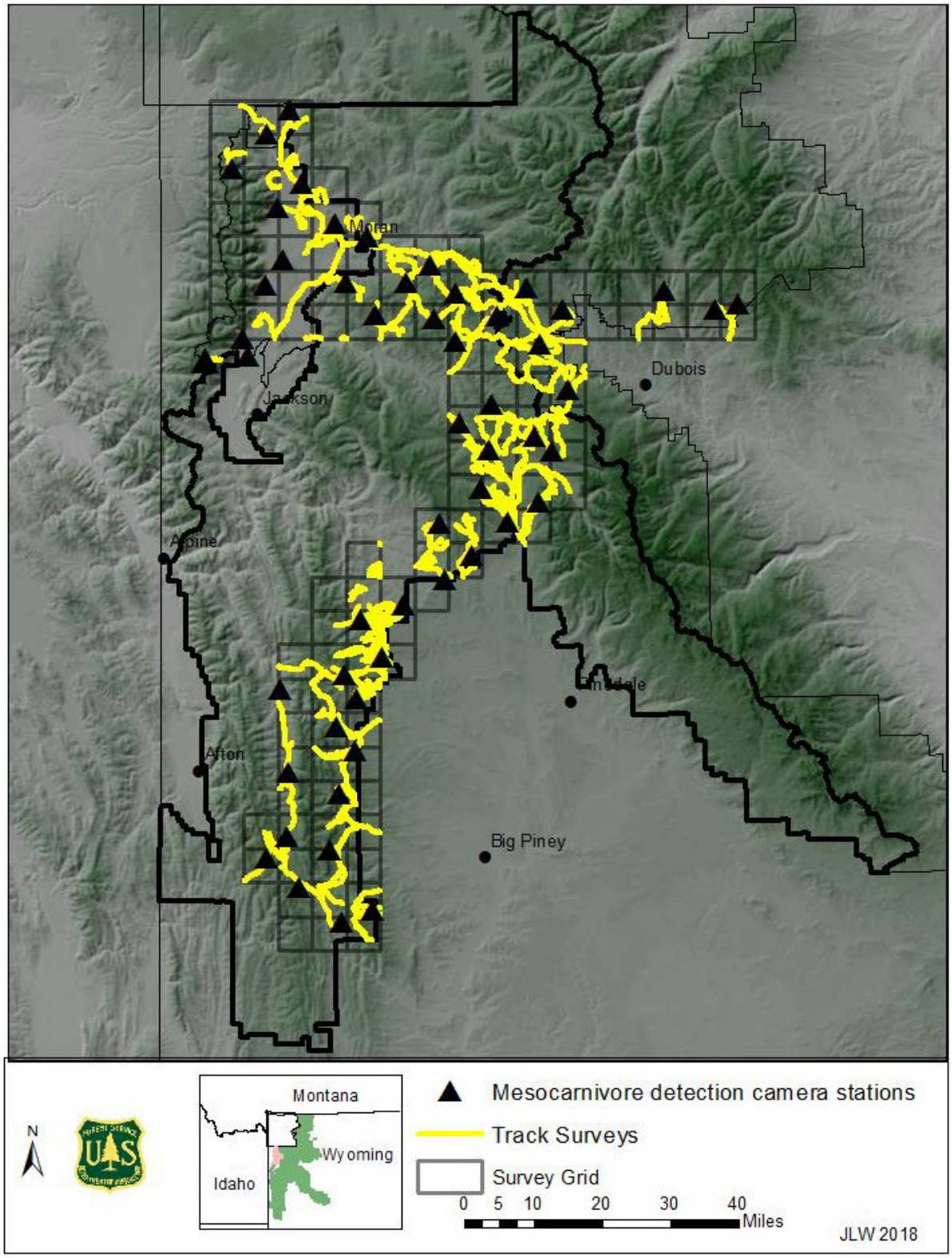

Figure 25. Distribution of mesocarnivore snow track surveys and camera/DNA stations, 2015-2017.

Discussion and findings

No evidence of Canada lynx was found in the study area over three winters of effort on a 1.9 million acre survey grid, including approximately 4,000 miles of 195 independent snowmobile and ski-based track surveys, 54 cameras that were active for a total of 37,500+ camera nights, analysis of a subset of 374 DNA samples, and after review of over 230,000 trail camera photographs of wildlife. While there exists high quality lynx habitat in the GYA, these habitats are patchy. The probabilities of detection certainly varied over the survey area due to field reality. The survey effort was closely aligned with well-established lynx and other mesocarnivore detection protocols. The lack of detections strongly suggest that lynx are not present in the areas surveyed. The lack of detections will be included in future status assessment for this species. Furthermore, US Fish and Wildlife Service has announced intention to delist Canada lynx; a proposed rule and a draft post-delisting monitoring plan scheduled to be in place by the fall of 2019.

Adaptive management considerations

Given their value in this monitoring period, incidental sightings, track surveys and eDNA should be added as a monitoring indicator for future monitoring periods. Based upon the monitoring results, no changes to the Forest Plan or management activities are warranted.

Question WDL-04: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the threatened yellow-billed cuckoo?

Indicator WDL-03-01: Acres of cottonwood overstory riparian habitat

Indicator WDL-03-02: Breeding Bird Survey (BBS) trend data for on-forest routes and incidental sightings

Summary of methodology

BTNF Existing Vegetation dataset was utilized to quantify cottonwood habitat. In this regionally produced dataset, vegetation map types were characterized by map unit (dominant land cover), tree and shrub canopy cover class, and tree size class, using field-based classification system and field keys, cross-walking existing vegetation information, and developing descriptions for the map units. The dataset was updated in 2018 using the Vegetation Classification, Mapping, and Quantitative (VCMQ) inventory data. Number of habitat patches, total acres, mean habitat patch size and range are assessed.

The USGS the Interactive Route Data Summary is queried for breeding bird survey route data (https://www.mbr-pwrc.usgs.gov/cgi-bin/rtena15a.pl?92&csrfmiddlewaretoken=3YKakk7LxT2ki6NSpl4mstudYCqdW02C). There are a total of five BBS Routes on BTNF: 92036 (Moose); 92052(Wilson); 92051 (Alpine); 92072 (Buckskin Mountain); 92071 (Soda Lake). In addition, the most current version of the Wyoming Natural Diversity Database is utilized to query any incidental sightings in or near BTNF.

Monitoring results

As of 2018, on BTNF, there are 83 cottonwood habitat patches, the mean patch size is 5 ac (range: 0.5-30 ac) and the total acres of habitat is 399 ac. There were three incidental sightings near BTNF in 2018 and no reports via the five BBS routes.

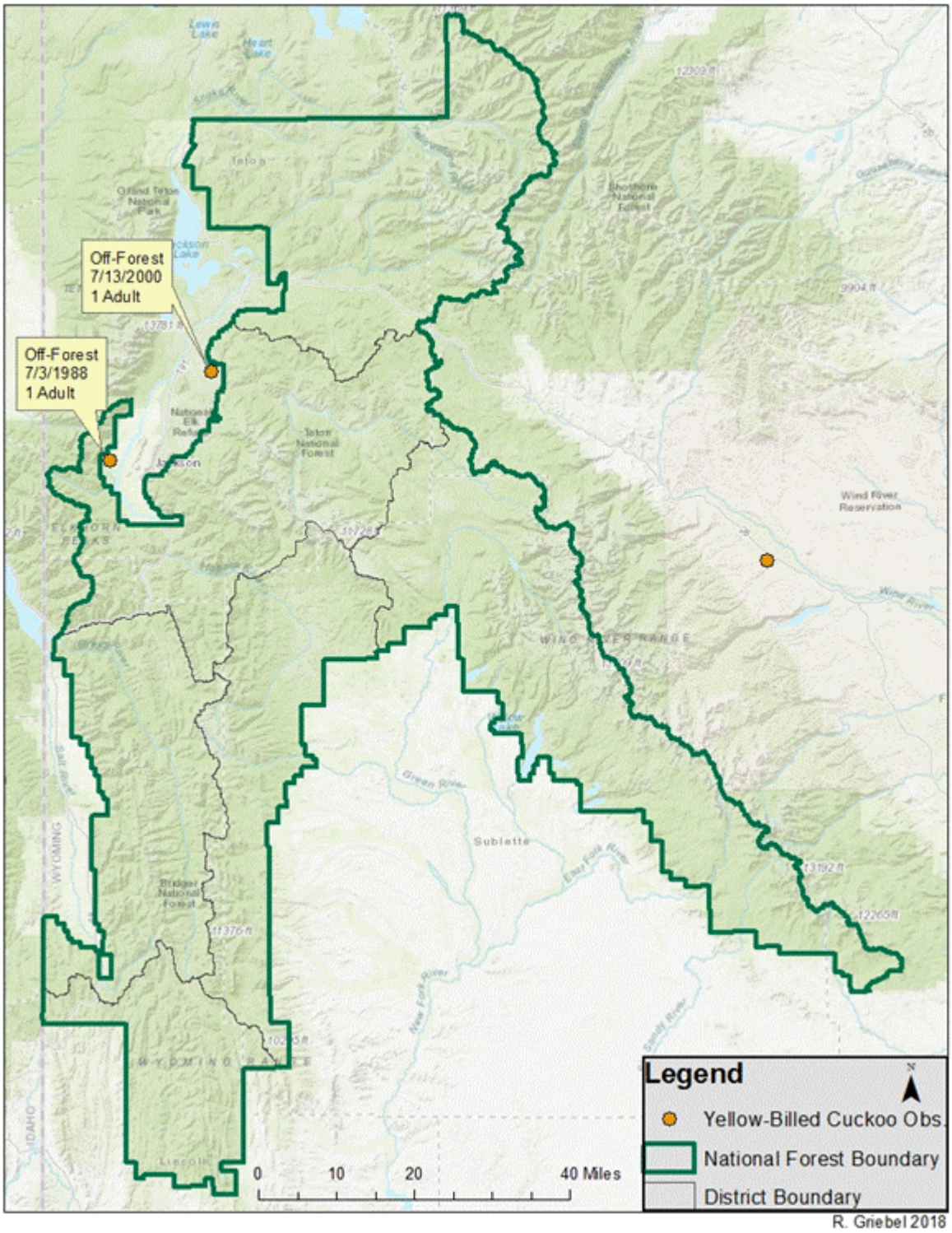

Figure 26. Yellow-billed cuckoo observations/recordings in or near BTNF, 2018

Discussion and findings

In Wyoming, the yellow-billed cuckoo is dependent on large areas of woody, riparian vegetation that combine a dense shrubby understory for nesting and a cottonwood overstory for foraging. Destruction,

degradation, and fragmentation of wooded, riparian habitats are threats to yellow-billed cuckoos in Wyoming. The species is extremely rare on BTNF, with few documented observations in or near the Forest boundary. On BTNF, there is no designated critical habitat; there is a very limited amount of cottonwood overstory habitat and little opportunity to increase that amount through management actions. There were no recordings of yellow-billed cuckoos on any of the BBS routes that are located on BTNF and the few incidental sightings that have been recorded are along the Snake River off-forest. Given the limited opportunity for habitat management, BTNF is meeting forest plan objectives in regards to yellow-billed cuckoo.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Question WDL-05: Are forest management activities and/or natural events affecting the ecological conditions that contribute to the recovery of the proposed North American wolverine?

Indicator WDL-05-01: Acres open to over-snow vehicle use and miles of groomed over-snow trails (e.g. motorized and non-motorized).

Indicator WDL 05-02: Amount and seasonal variation of snowpack

Summary of methodology

Acres open to over-snow vehicle use and miles of groomed over-snow trails is a duplicate of recreation indicators RA-03-01 and RA-03-02. For amount and seasonal variation in snowpack, USGS SNOTEL data was queried. From the available SNOTEL sites, a subset of five sites scattered across BTNF—all above 8500 feet—were selected to provide an index to assess snowpack in likely wolverine habitat: Togwotee Pass (9580’); Gros Venture Summit (8750’); Blind Bull Summit (8650’); Indian Creek (9425’) and Deer Park (9700’).

New science or information

Snow-track and camera trap survey efforts and incidental sightings were also included.

Monitoring results

There is a total of 1,839,514 acres open to snow vehicle use and 512 total miles of groomed over-snow trail (467 miles of groomed motorized trail and 45 miles of groomed non-motorized trail).

Table 15. Snow depths and snowpack duration at five SNOTEL sites, 2016 & 2018

2016	Blind Bull Summit	Deer Park	Gros Ventre Summit	Togwotee Pass	Indian Creek	AVG
First Day ≥ 60" of Snow Depth	2/16/2016	3/30/2016	N/A	2/16/2016	3/16/2016	
Last Day ≥ 60" of Snow Depth	4/30/2016	5/2/2016	N/A	5/2/2016	4/16/2016	
Total Days Between First and Last Day	75	34	0	77	32	43.6
2018	**Blind Bull Summit**	**Deer Park**	**Gros Ventre Summit**	**Togwotee Pass**	**Indian Creek**	**AVG**
First Day ≥ 60" of Snow Depth	1/12/2018	N/A	4/3/2018	12/24/2017	2/27/2018	
Last Day ≥ 60" of Snow Depth	5/21/2018	N/A	4/4/2018	5/29/2018	4/25/2018	
Total Days Between First and Last Day	130	0	2	157	58	69.4

Surveys and incidental sightings

BTNF conducted an intense snow-track and camera trap survey over three winter seasons from 2015-2017. A total of 54 camera stations were established as well snow-track surveys scattered throughout 1.9 million acres of BTNF and nearby Grand Teton NP, and the Shoshone NF. No wolverine tracks were identified nor were there any photos or DNA confirmed presence of wolverines at any camera station. BTNF continues to conduct snow-track surveys at a much reduced effort, focusing on high priority areas for both lynx and wolverine. There have been no detections to date on these routes and locations but we have confirmed two locations through incidental observations and DNA collection.

On March 9, 2018, BTNF Wildlife biologist Jason Wilmot found a putative wolverine track at Two-Ocean Pass. He was able to collect a musk sample and a single hair sample from this track. These samples were stored in a freezer then transported to the National Genomics Center in Missoula, MT; DNA analysis revealed a positive species ID for wolverine from both samples.

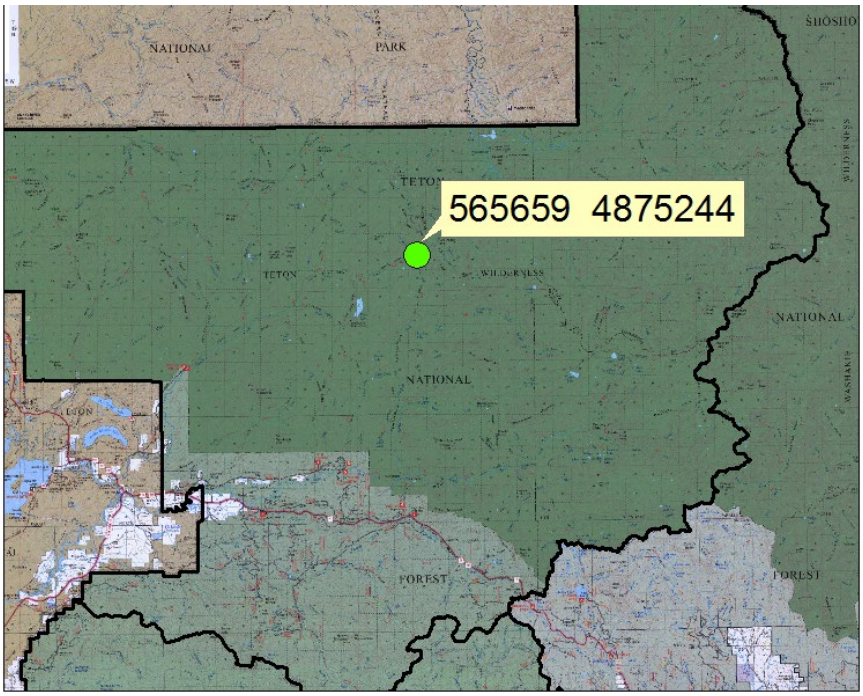

Figure 27. Location of wolverine track at Two-Ocean Pass (J. Wilmot).

Figure 28. Wolverine track at Two-Ocean Pass (Photo: J. Wilmot).

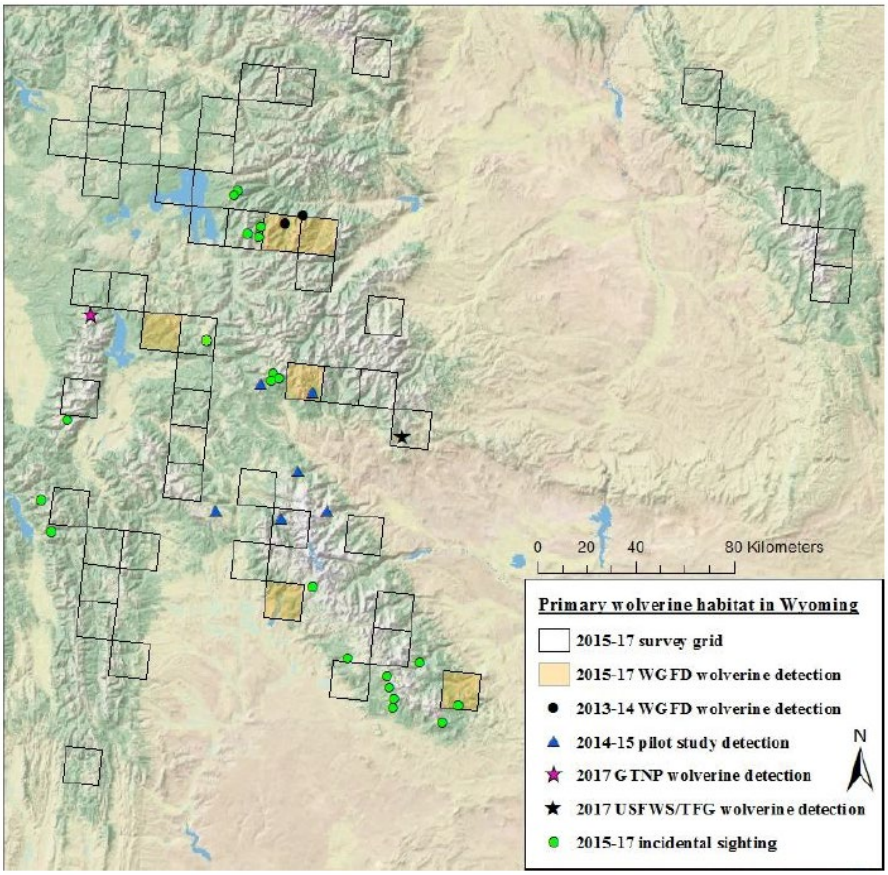

Figure 29. Incidental sightings and survey results for wolverine in Wyoming, 2013-2017. From Bjornlie et al 2017.

Discussion and findings

Wyoming Game and Fish Department (WGFD), as part of the Multi-state Wolverine Working Group, initiated the Western States Wolverine Conservation Project to assess current distribution and identify conservation actions (Welander 2015). During the winters of 2015-16 and 2016-17, WGFD documented ≥6 unique wolverines at 6 of 51 camera stations (Bjornlie and others 2017). Individuals were documented in the Wind River and Absaroka Mountains, all detections were in areas where wolverines have been documented either historically or as part of a recent pilot effort (2015) to evaluate techniques to detect wolverines in the state. However, wolverines were not detected in Yellowstone National Park or the Wyoming, Salt, or Teton Mountains, all of which also have documented historical presence. Even with two monitoring efforts going-on simultaneously, the species is rarely detected on BTNF, which is indicative of its solitary nature and rarity in the Greater Yellowstone Ecosystem.

On BTNF, winter recreation has changed little over the last 20 years in regards to groomed trails and acres open to snowmobile travel; it is expected to remain at current levels into the foreseeable future (i.e., miles of groomed trails and acres open to snowmobiling). Actual sightings and/or confirmed presence through tracks or DNA analysis is very rare on BTNF. Wolverines naturally occur at low densities and often move long distances in short periods of time, making it difficult to distinguish between animals that represent an established population or those that represent transient individuals moving through an area.

Climate-induced changes that reduce suitable habitat, especially snowpack, will have negative impacts on wolverine populations. Wolverines depend on high-elevation forests and alpine habitats, which are likely to contract gradually in the future. Wolverines have low reproductive rates that may decline further with loss of spring snow associated with preferred den sites (Halofsky and others 2018). The duration of deep snowpack (>60 inches) is tracked at five high elevation sites on BTNF since 2016, which is not sufficient time to establish a trend (TABLE 15).

Adaptive management considerations

Given their value in this monitoring periods, incidental sightings should be added as a monitoring indicator for future monitoring periods. Based upon the monitoring results, no changes to the Forest Plan or management activities are warranted.

Question RA-01: Are developed recreation sites managed to standard?

Indicator RA-01-01: Condition of recreation sites

Summary of indictor and methodology

Developed recreation sites include a variety of constructed facilities such as campgrounds, picnic areas, major trailheads, and interpretive sites. Each recreation site is inventoried on a five year cycle to assess annual maintenance needs (for preventing deterioration), deferred maintenance (infrastructure needing repair/replacement), and desired capital improvements (enhancement needed to meet increased demand and/or resource protection). The Facility Condition Index report displays the ratio of Deferred Maintenance to the Current Replacement Value of all the features at the recreation site to provide an estimate of overall site condition. This information was generated using the national online Recreation Toolkit, selecting the Recreation Site FCI List, and then filtering for sites on BTNF.

Monitoring results

The Facility Condition Index report shows that 30 developed sites (13%), out of a total of 230 sites, do not meet standard.

Discussion and Findings

BTNF completed a Recreation Site Analysis in 2015 to prioritize limited funding at particularly important sites as well as to identify changes in operations or maintenance that would improve important developed recreation sites. Since 2015, BTNF has strived to improve the condition of those sites identified as 'signature' (i.e. sites that best represent visitor and local user preferences and the character of the forest) and sites identified as necessary for resource protection. Improvement in site condition has occurred at some sites, where fees are charged and re-invested or where grant and partner funding has been obtained. However, with the loss of capital improvement funds and declining federal appropriations, needed site maintenance and improvement is not keeping pace with recreation demand and continued deferred maintenance. Additionally, lower priority sites often hold meaning for some members of the public and cannot be easily decommissioned to focus more attention on other sites.

Adaptive management considerations

In terms of the monitoring program, the information generated by the Facility Condition Index does not directly address the monitoring question. It is recommended that the Recreation Site Capacity Administered to Standard, often referred to as Recreation Sites Managed to Standard would provide better information that the Facility Condition Index. This metric takes into account the operational items at recreation sites and how well they meet the national quality standards identified for operating a recreation site for public use.

Based upon the monitoring results, no changes to the Forest Plan are warranted. In regards to management activities, BTNF is actively working toward addressing known site conditions issues.

Indicator RA-01-02: Change in extent of maintenance backlog

Summary of methodology

It was planned that these data would be queried from the INFRA Deferred Maintenance Module; however, no baseline data were generated prior to preparation of the 2015 Recreation Site Analysis, so change in maintenance backlog could not be produced. INFRA is a part of the Forest Service's NRM databases. Instead, the Forest's 2015 Recreation Site Analysis was utilized to provide information regarding maintenance needs.

Monitoring results

In 2015, BTNF categorized recreation sites based on a variety of sustainability criteria as part of the Recreation Site Analysis described for indicator RA-01-01. This process yielded a total of 84 key locations out of 239 that should receive management emphasis. These 84 sites include Signature Tourism, Signature Local, and sites necessary for Resource Protection. A total estimate of $4.12 million is listed as maintenance needed, including $365,000 for new infrastructure necessary to meet the current demand and protect resources. It is expected that $2 million of that could be raised through partners and fees. Only 20% of the signature sites (both tourism and local) generate fees; the rest of the facilities provide access points for summer and winter backcountry experiences (e.g. major trailheads or river access). Of the developments associated with resource protection, 62% are fee generating.

Discussion and findings

This indicator is similar to RA-01-01 above, providing another way to portray whether or not BTNF is making progress to improve the overall condition of recreation facilities. The two indicators complement each other with the change in extent of maintenance backlog reflecting the input side of the equation (how much managers are investing into site improvement) and the condition of recreation site indicator reflecting the outcome (i.e. the resulting condition). With limited funding, managers must make strategic choices to invest funding in the places that are most important to stakeholders and resource protection.

There is a substantial need for infrastructure maintenance on BTNF. Recreation managers are currently working with many partners obtain the funding needed to address critical maintenance needs. In terms of the monitoring program, managers will need to evaluate actions identified in the 2015 five-year plan and update INFRA; by 2020, changes in maintenance backlog should be more apparent more apparent. This metric will help inform whether progress is being made and if not, is there a need to perform a more rigorous prioritization effort and explore potential new funding mechanisms.

Adaptive management considerations

The monitoring program can be improved by better utilization of existing databases to track facilities data as well as focusing on the change in maintenance backlog for a subset of sites (i.e. those prioritized as most important for investment); this would yield more meaningful information to assess how the Forest is doing relative to stated priorities. Furthermore, additional monitoring periods are needed to evaluate the change in in maintenance backlog.

In regards to management activities, BTNF is actively working toward addressing known maintenance issues.

Indicator RA-01-03: Number of water systems that do not meet requirements

This information is queried from the INFRA Water Systems Module. INFRA is a part of the Forest Service's NRM corporate databases. As of 2018, there are two water systems that are not maintained to standard, out of 52 total; both are tuned off and not serving water. The Recreation Site Analysis addresses facility condition in a more integrated manner. As such, it is recommended that this indicator be dropped.

Question RA-02: Are the amount and types of recreation opportunities provided meeting customer needs and expectations?

Indicator RA-02-01: Visitation estimates, visitor activities, and percent overall satisfaction

Summary of methodology

Visitation estimates, visitor activities, and percent overall satisfaction are collected every five years via the National Visitor Use Monitoring (NVUM). Information about the visitor use monitoring program and Forest results can be found at: https://apps.fs.usda.gov/nvum. NVUM provides information that is valid and applicable at the national, regional and forest level, but it is not designed to be accurate at the district or site level. Estimating visitation is notoriously difficult because of the large number of National Forest access points, difficulty of developing an accurate stratified sampling scheme, and

highly variable nature of recreation use both spatially and temporally. The limitations of data are described in detail in each Forest's 5-year NVUM report.

A NVUM survey conducted from 10/1/2017 to 9/30/2018, but results have not been collated, so 2013 data are presented.

Monitoring results

Table 16. Visitation estimates, 2003-2013, NVUM

	2003	2008	2013
National Forest visits[1]	2.671 million +/- 23.2%	2.182 million +/- 20.1%	1.623 million +/- 11.4%
Site visits	3.15 million +/- 19.8%	2.369 million +/- 19.7%	1.951 million +/- 10.4 %

[1] A *national forest visit* is the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time; a national forest visit can be composed of multiple *site visits*.

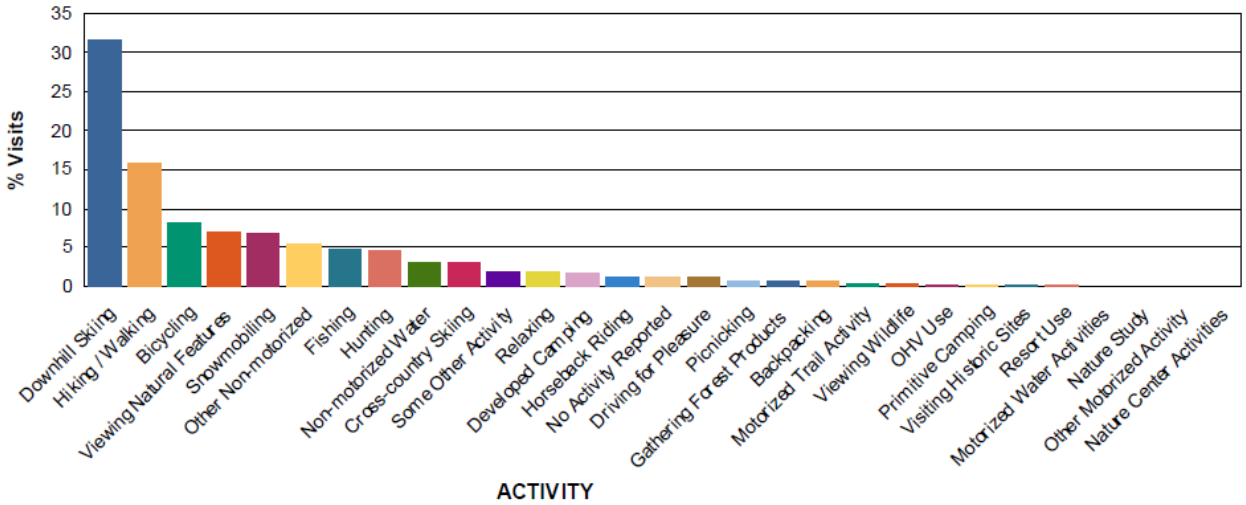

Figure 30. Primary visitor activities, 2013, NVUM

Table 17. Percent overall satisfaction, 2013, NVUM

Satisfaction Element	Satisfied Survey Respondents (%)[1]		
	Developed Sites[2]	Undeveloped Areas (GFAs)	Designated Wilderness
Developed Facilities	96.5	88.2	83.6
Access	92.5	91.8	85.0
Services	93.3	87.1	78.1
Feeling of Safety	98.3	100.0	97.6

[1]The proportion of satisfaction ratings scored by visitors as good (4) or very good (5) and indicates the percent of all visitors that are reasonably well satisfied with agency performance.
[2]Developed sites category includes both developed overnight and day use sites.

Discussion and findings

Visitation estimates over 5-year NVUM intervals should not be interpreted as clear trends in use. Problems in 2013 obtaining actual use data to help validate survey data likely contributed to lower visitation estimates on BTNF than expected (TABLE 16). Based on actual use in specific areas, BTNF visitation is likely at least two million people annually and is growing. The vast majority of visitors live in the counties that encompass or are adjacent to BTNF, with 60% travelling less than 50 miles for their visit and nearly 42% visiting more than 50 times annually. This information suggest that BTNF

plays a vital role in serving local communities, contributing directly to residents' quality of life and supporting local industry.

Visitation trends on BTNF likely mirror local population growth, since the vast majority of visitors reside in the counties that encompass or are adjacent to the Forest. From 2000-2017, Teton County, Wyoming's population grew 27% and adjacent counties with more affordable housing experienced even more rapid growth resulting in an overall 41% increase in population for the region (Headwater Economics) Increasing visitation combined with changing demographics and evolving technology is contributing to growing concern about visitor impact and social conflict in some areas of BTNF. The challenge of welcoming a growing population to connect with BTNF in a manner that sustains the attributes of the land and the experiences people value will be a key challenge in future forest planning.

On BTNF, top visitor activities have remained relatively constant, with downhill skiing, hiking/walking, bicycling, viewing natural features, snowmobiling, fishing and hunting being top draws (FIGURE 30). Downhill skiing is reported both by recreationists at developed ski resorts as well as by backcountry skiers/snowboarders. The primary activities reported by visitors are consistent with the values attributed to BTNF and reinforce the branding of the Forest as a world-class destination, especially in winter.

Visitor reports of satisfaction are generally high, since participants choose to visit voluntarily and many know what to expect, especially given the high percent of local and repeat visitors (TABLE 17). Satisfaction in developed and undeveloped settings is generally good, but there is some room for improvement for designated wilderness, such as trailhead facility conditions, trail conditions and availability of visitor information.

NVUM is not designed to be accurate at the district or site level. Management decisions regarding visitor use within the Forest typically require recreation data that is valid at the project or site scale. However, generating this information will require substantially more investment in monitoring than the Forest currently has funding or capacity to perform.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Indicator RA-02-02: Visitor numbers at ski areas, other resorts, and outfitter-guide services

Summary of methodology

This indicator captures a subset of the total visitor use occurring on BTNF that is authorized under special use permits (SUP). Unlike NVUM visitor estimates, SUP data is based on actual use reported by the permittees, thus there is less uncertainty about data accuracy. Outfitter and guest resort data was queried from the Forest Service's Special Use Database System (SUDS). Skier visits are tracked by each permittee (via lift ticket sales) and reported to BTNF each year.

Monitoring results

Table 18. Total skier visits at ski resorts, BTNF, 2011-2018

Resort	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
JH Mountain Resort	479,266	502,222	563,631	546,125	560,400	558,390	634,500
Snow King Mtn. Resort	45,162	32,177	37,200	35,434	40,901	38,967	41,285
White Pine Ski Area	0	15,759	14,934	15,000	12,385	13,842	15,034

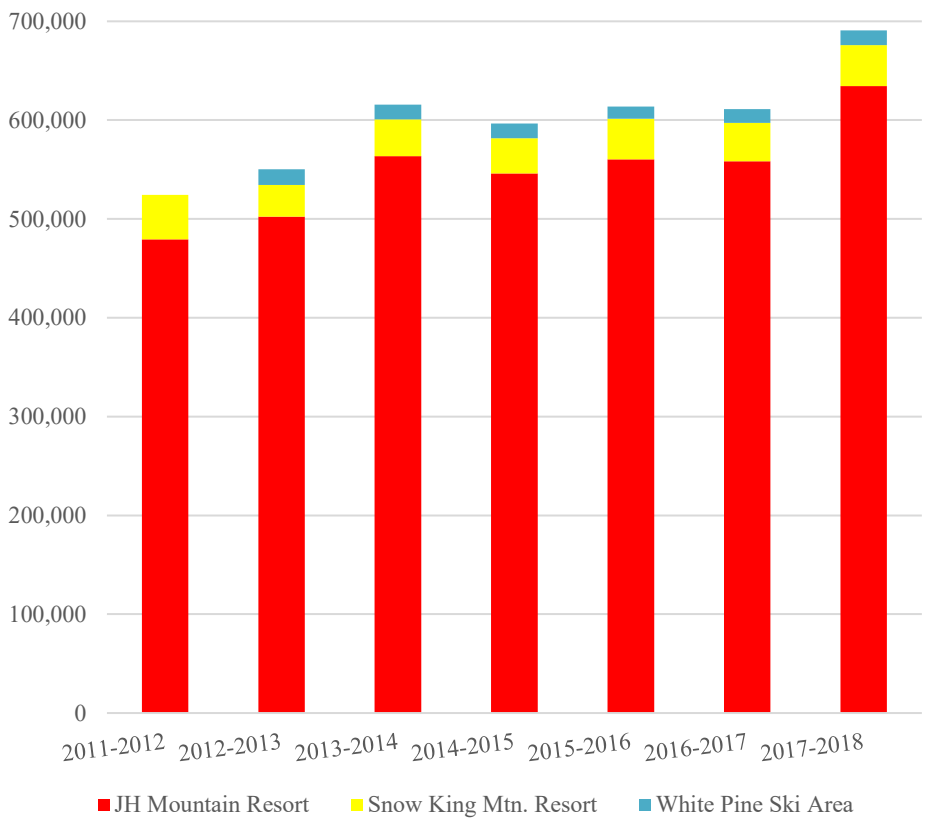

Figure 31. Total skier visits by ski resort, 2011-2018

Table 19. Room nights at guest resorts, BTNF, FY12 & FY18

Resort Name	FY12	FY18
Togwotee Lodge	18,859	14,698
Turpin Meadow Ranch	2,745	1,901
Heart 6 Ranch	No data	624
Big Sandy Lodge	563	790
Half Moon Lake Lodge	1,231	n/a (closed in 2018)
Lakeside Lodge	1,218	3,144

Table 20. Number of service days (actual use) provided by outfitter-guides, 2013-2018

Season	2013	2014	2015	2016	2017
Summer/fall outfitted use (includes pack trips, hunting, hiking/backpacking, rafting, fishing, bicycling, OHV tours, wagon rides, youth camps, etc.)	178,403	176,206	171,536	187,836	184,953
Winter outfitted use (includes skiing, snowmobiling, snowshoeing, avalanche education)	10,337	11,341	11,829	12,568	22,643

Discussion and findings

Visitation at ski areas on BTNF has increased 26% since 2012 (TABLE 18). Industry data suggests that increased visitation is not necessarily due to an increase in new users, but rather to existing skiers/snowboarders visiting more frequently. The increase in visitation has been largely driven by Jackson Hole Mountain Resort which had made major investments in marketing to national and international guests (FIGURE 31). In contrast, Snow King and White Pine ski areas cater more to local

skiers/snowboarders and have shown an overall upward use trend but with more variability, likely associated with the length and quality of the winter season. To remain viable, ski areas are diversifying their services to appeal to visitors during summer months. Current monitoring results does not capture the increased summer visitation ski areas are experiencing.

Guest ranch use has been highly variable on BTNF, likely due to changing ownership and downturns in the economy (TABLE 19). The exception is Togwotee Lodge which has sustained consistent use, likely due to its location as a premier snowmobile destination.

BTNF supports the largest outfitter-guide program in the Intermountain Region and one of the largest in the nation, but outfitting still accounts for only a small portion of the total visitor use on BTNF. There is a clear trend of increasing outfitter use on BTNF since 2012, especially in winter (TABLE 20). This is likely due to the increasing popularity and diversification of winter activities combined with relatively consistent quality snow on BTNF. Within the outfitting industry, one apparent trend is the acquisition of businesses by larger corporations who have the finances to invest more in the operation and can weather losses that may occur due to yearly fluctuations. The trend in both summer and winter outfitter use is likely to continue upward since actual use is less than the amount of use authorized and there continues to be demand for existing outfitted services and high interest in new services.

Adaptive management considerations

This indicator includes useful metrics and should be retained but it is recommended that visitation at guest ranches be dropped in favor of capturing summer use at ski/mountain resorts.

With respect to outfitting demand, the Forest Service is implementing 'Special Use Modernization' to help remove barriers to outdoor services that require special use permits. BTNF has also strived to respond to changing public desires by offering some new services, issuing temporary use permits, and working with permittees to modify authorizations as businesses transfer to new operators.

Indicator RA-02-03: Annual percent occupied sites in campgrounds and picnic areas

Summary of methodology

For campgrounds operated by BTNF, site occupancy data is collected by BTNF recreation staff and is recorded in the Forest Service's Point of Sale System (POSS). For sites operated by a concessionaire under special use permit, site occupancy is reported in annual use reports. Site occupancy is collected only in developed campgrounds and other developed sites where a fee is charged and there are facilities and services provided for visitors such as picnic tables, fire rings or grills, restrooms, water, on-site hosts, and garbage service. Occupancy data for picnic areas is generally incorporated into campground data and not reported separately.

Monitoring results

Table 21. Occupancy at developed recreation sites, BTNF, 2013-2017

	2013	2014	2015	2016	2017
FS-operated campgrounds	Average occupancy for all campgrounds is estimated to currently be 58% with a stable trend				
Concession operated campgrounds	36%	36%	50%	62%	73%
Granite Hot Springs	23,038 people	21,250 people	32,009 people	28,101 people	25,666 people

Discussion and findings

Since at least 2013, there has been a notable upward trend in camping on BTNF (TABLE 21). The high occupancy rate in 2017 was directly attributed to the solar eclipse event that attracted more than 40,000 people in August. In anticipation of increased use, some campgrounds were temporarily expanded. The upward trend is unevenly distributed across BTNF, with the Jackson and Blackrock areas experiencing a more rapid increase in camping use, partly due to overflow from the adjacent National Parks. All areas have experienced an increase in people seeking sites that accommodate larger RVs, sites that accommodate large groups, and year-round parking areas for self-contained vans/campers.

BTNF offers approximately 42 developed campgrounds and 652 recreation sites. Historically, visitors had plenty of opportunities to find available sites. For the most part, visitors still can find an available site without advanced reservations, except at very popular sites during the peak summer season.

Adaptive management considerations

During data collation for this report, it became apparent that data storage and management varied greatly between districts and concessionaries. This dataset is not aggregated into one database and there is no standardized protocol for data collection or storage. This made data aggregation challenging and reduced confidence in data accuracy. BTNF is working to standardize its data collection protocols to improve this dataset for future monitoring periods.

In terms of address the increased use of campgrounds, BTNF generally considers potential expansion of developed site capacity when an entire campground's occupancy approaches 70%. In response to the upward trends in the Jackson and Blackrock area, expansion of certain campgrounds is being considered. BTNF have also prepared more specific information to assist people with large RVs find accommodations. Additionally, more guard stations have been renovated to make them available for rental (e.g. Sherman, Green River Lakes Lodge).

Indicator RA-02-04: Acres providing various classes of recreation opportunity (ROS)

Summary of methodology

Recreation Opportunity Spectrum (ROS) is used to inventory, evaluate and develop plan direction for recreation settings and opportunities. National protocols have been developed to categorize and map areas within the National Forest System. This effort was completed on BTNF in 2006 and updated as needed; data is queried from BTNF corporate GIS. There are six broad settings (TABLE 22).

Monitoring results

Table 22. Acres in each Recreation Opportunity Spectrum setting, BTNF, 2018

ROS	Class Description	Acres
Primitive	Opportunity for isolation from man-made sights, sounds, and management controls in an unmodified natural environment. Only facilities essential for resource protection are available. A high degree of challenge and risk are present. Visitors use outdoor skills and have minimal contact with other users or groups. Motorized use is prohibited.	Wilderness: 1,137,335
		Non-Wilderness: 279,242
Semi-primitive non-motorized	Some opportunity for isolation from man-made sights, sounds, and management controls in a predominantly unmodified environment. Opportunity to have a high degree of interaction with the natural environment, to have moderate challenge and risk and to use outdoor skills. Concentration of visitors is low, but evidence of users is often present. On-site managerial controls are subtle. Facilities are provided for resource protection and the safety of users. Motorized use is prohibited.	Wilderness: 158,819
		Non-Wilderness: 1,147,083

Semi-primitive motorized	Some opportunity for isolation from man-made sights, sounds, and management controls in a predominantly unmodified environment. Opportunity to have a high degree of interaction with the natural environment, to have moderate challenge and risk and to use outdoor skills. Concentration of visitors is low, but evidence of other area users is present. On-site managerial controls are subtle. Facilities are provided for resource protection and the safety of users. Motorized use is permitted.	289,214
Roaded Natural	Mostly equal opportunities to affiliate with other groups or be isolated from sights and sounds of man. The landscape is generally natural with modifications moderately evident. Concentration of users is low to moderate, but facilities for group activities may be present. Challenge and risk opportunities are generally not important in this class. Opportunities for both motorized and non-motorized activities are present. Construction standards and facility design incorporate conventional motorized uses.	356,149
Rural	Area is characterized by a substantially modified natural environment. Opportunities to affiliate with others are prevalent. The convenience of recreation sites and opportunities are more important than a natural landscape or setting. Sights and sounds of man are readily evident, and the concentration of users is often moderate to high. Developed sites, roads, and trails are designed for moderate to high uses.	55,015
Urban	Area is characterized by a substantially urbanized environment, although the background may have natural-appealing elements. High levels of human activity and concentrated development, including recreation opportunities are prevalent. Developed sites, roads and other recreation opportunities are designed for high use.	6,001

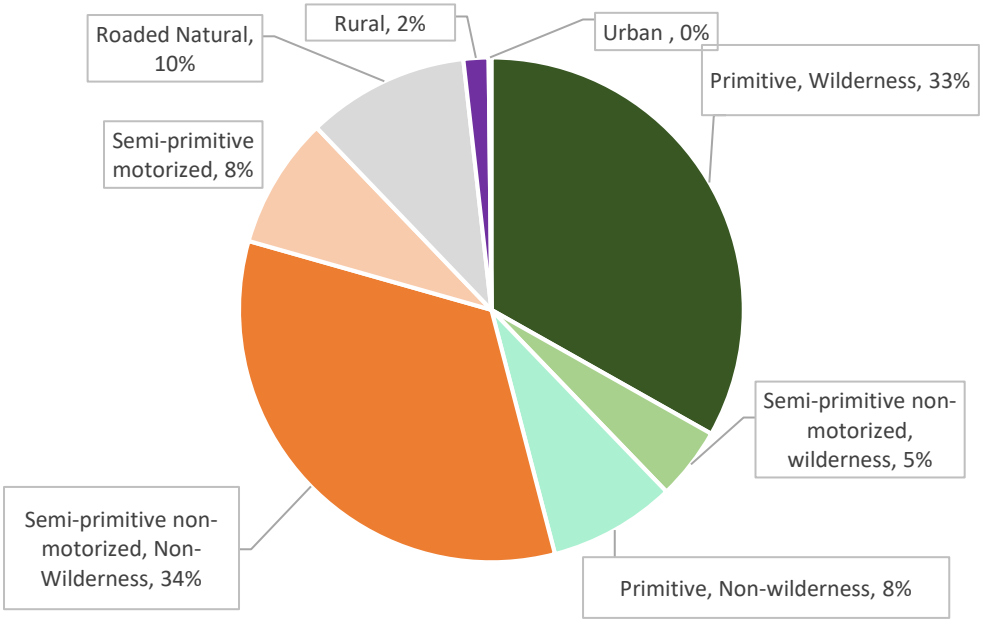

Figure 32. Percentage of BTNF acreage by Recreation Opportunities Spectrum setting, 2018

Discussion and findings

BTNF is dominated by land that offers primitive or semi-primitive opportunities, including approximately 38% wilderness (TABLE 22, FIGURE 32). Rural and urban settings are present in localized areas (e.g. recreation residence tracts, ski resorts) and thus occupy relatively small acreage. Categorization of areas in the six different settings tends to be relatively stable over time.

With increasing human use and development, there is a tendency for areas to transition from a primitive or semi-primitive setting to a more developed setting (e.g. roaded-natural or rural). Development of roads and physical structures are examples of activities that quickly change the setting; however, more subtle activities, such as increased visitor use with subsequent increased managerial presence can result in a primitive setting becoming semi-primitive. Once human uses have

become established, it is difficult to move the other direction. Moving an area to a more developed setting can sometimes expand the mix of desired recreation opportunities and help accommodate high use by providing the infrastructure that makes a site more resistant to impact.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Question RA-03: Does the Forest road and trail system provide for motorized and non-motorized recreation opportunities in both summer and winter?

Indicator RA-03-01: Acres open to over-snow vehicle use

Summary of methodology

BNTF corporate GIS of over-snow vehicle use and miles of groomed over-snow trails was queried for 2018. The calculation reflects the acres open to over-snow vehicle use (including cross-country use) plus the acres associated with designated over-snow vehicle trails that exist within restricted areas.

Monitoring results

Currently, 1,839,514 acres are currently open to over-snow vehicle use, which amounts to 54% of BTNF (total acreage of BTNF is approximately 3,402,684 acres, based on 2011 Land Status Report).

Discussion and findings

The trend in areas open to over-snow vehicle use on BTNF has been relatively stable since 1990, while winter recreation use (both motorized and non-motorized) has exponentially increased. Areas are generally open to over-snow vehicle, except within Congressionally-designated areas that prohibit such use (e.g. wilderness) and where management decisions have been made to restrict over-snow vehicle use to protect natural resources (e.g. wintering wildlife) or reduce conflict with non-motorized use or other land uses (e.g. ski resorts). Additionally, not all acres open to over-snow vehicle use are necessarily usable; some terrain is simply too steep (e.g. cliffs, rock outcrops) and some terrain may not have the snow-cover to be usable in a drought year.

A framework for managing over-snow vehicle use is found in the National Travel Management Rule (2015). The rule requires publication of an over-snow vehicle use map (OSVUM) based on local management decisions made in accordance with the National Environment Policy Act. The Bridger-Teton National Forest published an OSVUM for the Jackson and Blackrock Ranger Districts in 2016, reflecting past management decisions but it was withdrawn in December 2017 under legal challenge. The Jackson and Blackrock Ranger Districts currently manage winter over-snow vehicle use in accordance with the Teton Division Winter Travel Map with accompanying Forest special orders. Other districts have forest special orders that apply to specific areas but do not have an overall Winter Travel Map that displays areas open to over-snow vehicle use.

Adaptive management considerations

Eventually, every Ranger District on the Bridger-Teton National Forest will need to publish an OSVUM that complies with the requirements found in subpart c of the National Travel Management Rule. Updating the Forest Plan provides an opportunity to develop more direction on desired winter settings. This direction would help frame subsequent site-specific management decisions to provide

winter recreation opportunities (considering the right use in the right location), protect wintering wildlife, and minimize conflict among different uses.

Indicator RA-03-02: Miles of groomed over-snow trails (motorized and non-motorized)

Summary of methodology

It was planned that monitoring data would be queried from INFRA databases, which includes data on snow trails, however this information needs to be updated and is currently inaccurate. INFRA is a part of the Forest Service's the Natural Resource Manager (NRM) system; information about these databases is available at http://fsweb.nrm.fs.fed.us/. Instead, to calculate groomed trail mileage, BTNF winter travel maps were digitized and stored in BTNF corporate GIS.

Monitoring results

Total miles of groomed over-snow trail is 512 miles, with 467 miles of groomed motorized trail and 45 miles of groomed non-motorized trail. Non-motorized groomed trails occur in the following six areas: White Pine, 14.5 miles; Turpin Meadows, 6.7 miles; Trail Creek, 2.9 miles on NFS; Salt River Pass, 5 miles; Cache Creek, 5.5 miles; Game Creek 3.2 miles. There is an additional 7.5 miles of groomed single-track trail in Cache Creek.

Discussion and findings

BTNF offers one of the largest networks of winter trails in the Intermountain Region. Miles of available groomed motorized trail has remained relatively stable over time, although some lightly used trails were dropped and low snow years have constrained the miles of trail that can be groomed as well as the length of the use season. BTNF partners with Wyoming State Trails to groomed motorized trails throughout BTNF, including the popular Continental Divide Snowmobile Trail which spans multiple districts. State snowmobile permitting fees support trail grooming. Groomed snowmobile trails are increasingly used for both motorized and non-motorized recreation activities.

The amount of groomed non-motorized trail on BTNF has been increasing, due to support of partner organizations and special use permittees. Both White Pine Ski Resort and Turpin Meadows Ranch maintain groomed trails. JH Ski and Snowboard Club maintains a nordic ski training facility at Trail Creek which is partially located on National Forest System lands. Teton County Parks and Recreation Department grooms many trails and pathways in Jackson Hole, including two trails on BTNF which are used primarily for non-motorized activities, but are open to snowmobile use. Friends of Pathways grooms about 7.5 miles of single-track trail in Cache Creek. BTNF grooms one ski trail on Salt River Pass. Non-motorized trails are generally groomed for nordic skiing but are used for a variety of activities, including snow-showing, walking, running and fat biking.

Adaptive management considerations

BTNF currently offers an extensive network of groomed snow trails, thus there is no compelling need to greatly expand the network, especially given wildlife concerns. However, with increased winter recreation use, there is likely some opportunity for more resorts and guest ranches to offer a diversity of winter activities, including those dependent on groomed trails. Walking or running on packed trails and fat biking are fast-growing activities, suggesting a potential need for more single-track grooming. Future challenges center on sustaining the funding necessary to support grooming operations and managing the increasing diversity of different uses occurring on groomed trails so that conflict is minimized.

Indicator RA-03-03: Miles of non-snow (summer) trails maintained for motorized and non-motorized use

Description of methodology

Forest Service classifies trails as either *system* or *non-system*. System trails are defined as those trails necessary for the protection, administration and use of National Forest System land. They are included in BTNF's transportation system, eligible to receive maintenance funds and often have some level of design and construction effort. In contrast, non-system trails are typically trails created by human use or animals and not considered part of the BTNF transportation system. This indicator only includes system trails. Mileage is queried from INFRA trails database, which was updated on BTNF in 2018 as part of a national focus on updating trail data quality. INFRA is a part of the Forest Service's NRM corporate databases.

Monitoring results

There are 2,808 total miles of summer trails on BTNF, of which 2,564 is non-motorized and 244 miles are motorized.

Discussion and findings

BTNF provides one of the largest summer trail networks within the Intermountain Region. Compared to the national average (62%), the portion of non-motorized trails on BTNF is high (91%). This is a result of the relatively high portion of BTNF that are wilderness and roadless backcountry areas where roads cannot be constructed and access is limited to mostly non-motorized trails. Furthermore, motorized trails must be designated through a travel management process. Total miles of trail has been increasing on BTNF for several reasons: 1) more accurate GPS inventories; 2) planning efforts have added existing non-system trails to the system or converted roads to motorized trails to address changing public desires and resource issues and 3) projects have added trails for summer operations at resorts.

Adaptive management considerations

In general, BTNF is meeting the forest plan objective to provide trail-based recreation. The interest in trail-based recreation is growing, but also evolving. As a result, some trails could be removed from the system in favor of other trails with higher public interest. Strategic trail assessments could be used to help inform decisions about the future trail system to ensure its economic, environmental, and social sustainability. Specific to motorized trails, area-specific travel management planning is needed where decisions pre-date the 2005 National Travel Management Rule to reflect changes in motor vehicle technology and growing interest in trail-like experiences.

Indicator RA-03-04: Miles of trail maintained to standard

Summary of methodology

Trail miles maintained to standard includes all system trails (see RA-03-03) that meet quality standards and have been maintained in accordance with a specific maintenance cycle associated with each trail's management objective (TMO). Trails are classified from Class 1-5 by how developed they are. Class 1 trails are minimally developed, such as those with natural fords instead of bridges in wilderness areas, and are designed to provide a challenging recreation opportunity, usually in a natural and unmodified setting. Conversely, Class 5 trails, such as those found at visitor centers or high-use recreation sites, are fully developed, have gentle grades, and are often paved. To meet standard a trail needs to have been maintained per its maintenance cycle (e.g. annually, every 3 years, every 5 years) and meet the standards associated with the trail's management objective. Percentage of trail system

maintained to standard is reported annually in INFRA Trails database and is partially informed by Trail Assessment and Condition Surveys (TRACS) completed for a subset of trails. INFRA is a part of the Forest Service's NRM corporate databases.

Monitoring results

As of 2018, an estimated 16% of BTNF system trails are maintained to standard.

Discussion and findings

BTNF is challenged to sustainably maintain and manage an extremely large and growing network of summer trails. Nationally, only 25% of the Forest Service trail system is maintained to standard with an estimated trail maintenance backlog of $314 million in fiscal year 2012 (Government Accountability Office 2013). The below national average percentage of trails maintained to standard on BTNF (16%) is likely due to the relatively large system compared with other Forests (see indicator RA-03-03), but is compounded by chronic funding shortages for maintenance activities and lack of staff capacity. Partners and volunteers play a significant role is assisting BTNF with trail maintenance funding and implementation, but this still require agency support to ensure quality work and perform some tasks that cannot feasibly be implemented by partners. Overall, the trend in the miles of trail maintained to standard on BTNF has been relatively stable.

Adaptive management considerations

In 2017, the Forest Service released the National Strategy for a Sustainable Trail System (http://www.fs.fed.us/recreation/programs/trail-management/strategy/index.shtml) and efforts are underway to implement this strategy. In addition, recent legislation (i.e. National Trails Stewardship Act PL 114-245, 2016) aims to increase volunteer and partner involvement in trail maintenance. BTNF has recently hired more field trails staff using funds generated under the Federal Land Recreation Enhancement Act. Improving the percent of the trail system maintained to standard will require implementation of the National Trails Strategy, completing strategic trail assessments to ensure limited funding is being put in the right places, investing in staff capacity and skill development, and cultivating more long-term partnerships to reduce maintenance backlogs.

Indicator RA-03-05: Miles of road maintained to standard

Summary of methodology

Miles of road maintained to standard is queried from INFRA Roads Module. INFRA is a part of the Forest Service's NRM corporate databases.

Monitoring results

In 2018, BTNF maintained 108 miles of trail to standard, which is approximately 6.5% of the total road system.

Discussion and findings

During data collection for this report, it became apparent that this indicator does not seem meaningful as a reflection of overall recreation access or the forest's responsiveness to road maintenance issues. The regional forester's annual target for miles of road maintained to standard on BTNF is approximately 20% of BTNF's road system. BTNF reports on this target in INFRA, but, in general, not additional miles are entered into the database.

Adaptive management considerations

It is recommended that this indicator be dropped. BTNF is exploring other monitoring indicators that may better reflect road access for recreation. No changes to the Forest Plan or management activities are warranted.

Question WSR-01: Are the free-flowing conditions, water quality, and Outstandingly Remarkable Values for Wild and Scenic Rivers maintained and protected?

The Wild and Scenic Rivers Act requires that managers protect and enhance a designated Wild and Science River's (WSR) free-flowing condition, water quality, and outstandingly remarkable values. BTNF published a Comprehensive River Management Plan (CRMP) in 2014 to provide direction for managing and monitoring designated WSR segments (USDA Forest Service 2014). The three indicators selected for this monitoring report were identified as part of the CRMP to address whether or not recreation use was being managed within the estimated capacities. However no national protocols exist for these indicators, obtaining the data is very labor intensive, no corporate database exists, and the suite of indicators do not directly address free-flow conditions and water quality.

For future monitoring reports, it is recommended that indicator WSR-01-01 be retained but the indicators related to campsite and vehicle area occupancy be dropped in favor of two new indicators that are based on more readily available data and better address the totality of free-flow condition, water quality, and outstandingly remarkable values. The recommended indicators for future monitoring periods would be:

WSR-01-01: Indicator: Watercraft use in Wild and Scenic Rivers

WSR-01-02: Indicator: Number of authorizations for federal water projects

WSR-01-03: Indicator: Miles of river or creek with degraded water quality

Indicator WSR-01-01: Watercraft use in Wild and Scenic Rivers

Summary of methodology

As outlined in the 2014 CRMP, monitoring should be conducted by counting total number of watercraft observed passing by a selected location per standardized unit of time (typically an 8-hour day) within the Wild and Scenic River (WSR) corridor during the primary use season (USDA Forest Service 2014). For WSR rivers located in designated Wilderness or Wilderness Study Areas (i.e. Buffalo River, Gros Ventre River and Willow Creek), watercraft use should be recorded as presence or absence on each monitoring day. Currently, BTNF is still in the process of setting up its WSR monitoring program. In the interim, data are provided on the total number of boats per season on the Snake River from outfitter reports. Data on the Hoback River and Granite Creek were collected via cameras positioned to capture the number of boats on six or seven random days. So, the total number of boats listed is only a sample and is likely an underestimate of total use.

Monitoring results

Table 23. Total boats per season and average boats per day on selected Wild and Scenic Rivers, 2018

River	Total number boats / season	Average number boats / day	Peak dates	Number boats on peak dates	Notes
Snake River (main)	13,436 (plus 2,588 fishing boats)	129	7/4; 8/17	204	Total only includes use managed under permit

Hoback River[1]	75	10.7	7/15	22	Based on seven days between 6/17 and 8/5
Granite Creek[1]	38	6.3	8/10	13	Based on six days between 6/17 and 8/10

[1]Total number of boats listed is only a sample from 6-7 days and is likely an underestimate of total use.

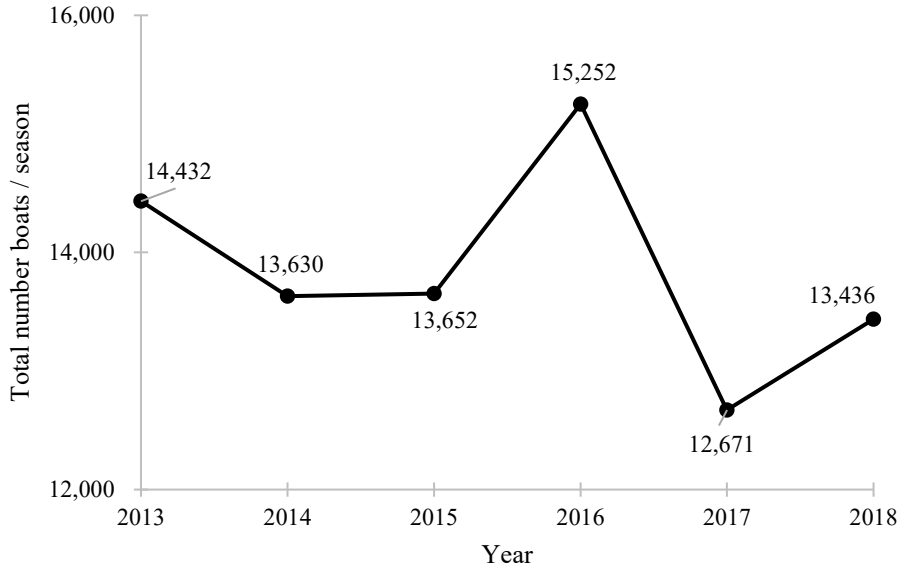

Figure 33. Total boats per season, Snake River (main), 2013-2018. Additional fishing boats: 2,506 in 2015 & 2,588 in 2018

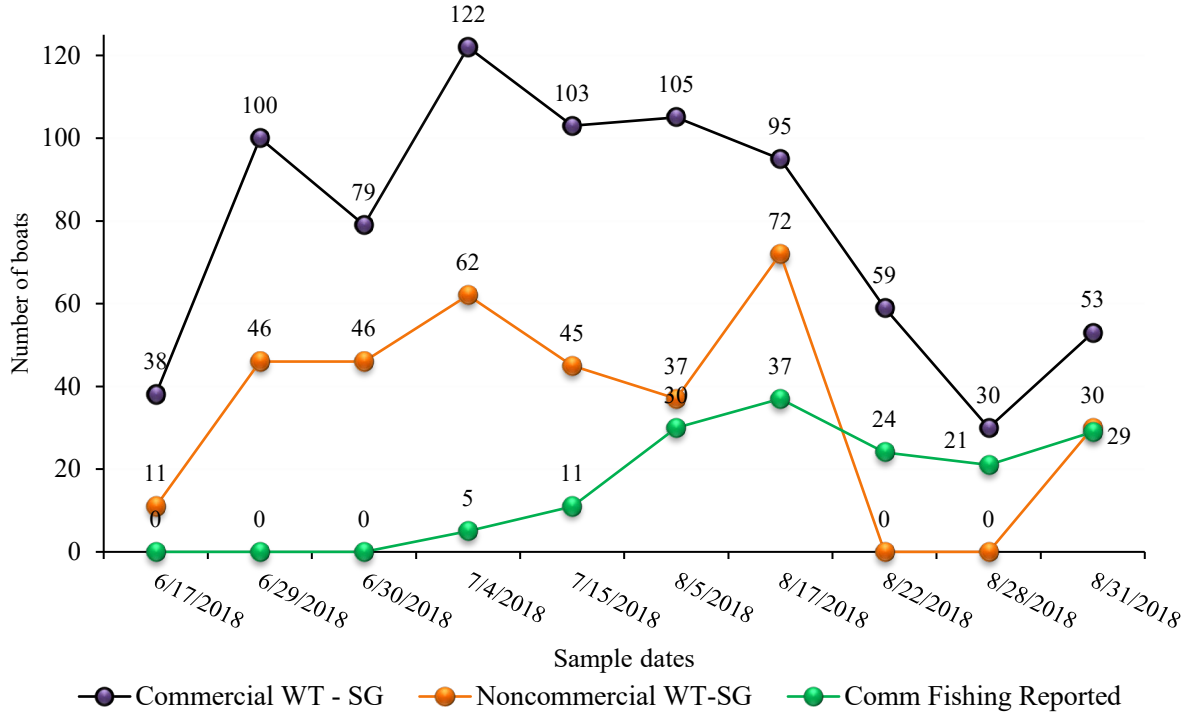

Figure 34. Number of boats by user group, Snake River (main), 6/17-8/31/2018

Discussion and findings

On the Snake River, BTNF established defined boat capacities to address commercial whitewater, float fishing, and instructional river use; a permit system is in place to manage guided organizational river use and groups over 15 people. This has stabilized the rapid growth in whitewater river use that occurred in the mid-1990's (FIGURE 33). While whitewater rafting use on the Snake River is currently managed within established capacity, but float fishing use is increasing (FIGURE 34). As a result, boat capacity trigger points are sometimes exceeded, necessitating a reduction in the number of boats allowed per day the following year. Peak use appears to be in July (FIGURE 34, TABLE 23).

Far less information is available about non-commercial boat use on the Snake River and about overall use on other designated rivers where commercial use is limited and general public use is highly variable. On the Snake River, the number of boats reported is only from reports from outfitters and does not quantify non-commercial use (TABLE 23, FIGURE 33). For Hoback River and Granite Creek, the data presented are only from a 6-7 day sample period, so total use is likely greatly underestimated. Furthermore, there are several additional WSR segments that are not currently monitored. Wilderness WSR monitoring has not produced any observations of boating activity on segments of wild rivers. Pack rafting certainly occurs on some wild rivers but the current use is so low and variable, it has not been directly observed.

Adaptive management considerations

Monitoring watercraft use is a labor intensive task. BTNF currently lacks sufficient staff capacity to develop a rigorous protocol and adequately monitor watercraft use on all designated rivers in the Upper Snake River headwaters. Camera technology is being tested to improve the efficiency of data collection and should improve the accuracy and reliability of monitoring. Despite the obstacles, monitoring watercraft use offers the best indicator to assess whether visitor use is being managed within estimated capacities. No change to this indicator is recommended and no changes to the Forest Plan or management activities are warranted.

Indicator WSR-01-02: Occupancy of dispersed campsites in Wild and Scenic River corridors

Summary of methodology

Monitoring occurs only on river segments classified as scenic: Buffalo River, Pacific Creek, Gros Ventre River, and Granite Creek. BTNF recreation staff conduct field patrols of designated campsites and monitor presence of camper to track overnight visitation, which is tracked via hardcopy field reports. BTNF recreation staff currently collect daily field patrols as part of Wyoming State funded off-road vehicle education and enforcement patrols. However, the focus of these patrols is contacting visitors with area information, conveying information about forest regulations, and ensuring compliance with the requirement to obtain a state ORV permit. Since 2005, data have been collected for the Gros Ventre and Granite Creek corridors, but they focuses on the number of people contacted and not whether campsites are occupied. Furthermore, reports are still hardcopy, has not been compiled in a corporate database or analyzed.

Monitoring results

None available.

Discussion and findings

In order to reliably monitor and evaluate data for campsite occupancy, all dispersed sites within WSR corridors would need to be inventoried and mapped. Additionally, a designated site system would need to be established so that the percentage occupancy is not based on a changing number of sites or could

be adjusted based on the new number of sites. Currently, of the four river segments included in this monitoring, only Pacific Creek has established designated dispersed sites. A designated site system is being implemented in the lower Gros Ventre corridor but implementation in other designated river corridors is not planned in the next few years. Monitoring occupancy of dispersed campsites is necessary to properly manage dispersed recreation but is only practical where a designated site system has been established. With increasing dispersed camping use, the Forest Service will need to devote more attention to managing and monitoring dispersed recreation.

Adaptive management considerations

For proposed monitoring program changes, see discussion of indicator changes under Question WSR-01. Monitoring dispersed camping will help inform project level decisions but monitoring this indicator is not recommended for Forest Plan scale decisions.

Indicator WSR-01-03: Occupancy of vehicle access areas

Summary of methodology

Only those river segments where day use predominates are monitored: Snake River (main), Hoback River and Crystal Creek and Wolf Creek. When the monitoring protocol was developed, it was planned that occupancy would be monitored using camera technology to capture information about whether the number of vehicles parked in selected locations is exceeding the capacity of the parking area and spilling onto roadways. To date, this monitoring has not been established.

Monitoring results

None available

Discussion and findings

Using camera technology is the most efficient way to collect information about when parking areas are exceeding capacity parking area and spilling onto roadways. Funding limitations have prevented BTNF from installing cameras. Field observations by BTNF recreation staff suggest that, in general, parking areas are not exceeding capacity on a regular basis during peak use season. While this indicator could potentially yield valuable information, the cost of obtaining the information currently exceeds the value of the information.

Adaptive management considerations

For monitoring program changes, see discussion of indicator changes under Question WSR-01. Monitoring this indicator may be necessary in the future to inform project decisions but is not recommended for Forest Plan monitoring.

WLDN-01: Do management activities in designated wilderness preserve wilderness character?

The 1964 Wilderness Act requires that managers preserve wilderness character. For the purposes of monitoring, wilderness character is defined as a holistic concept based on the interaction of the following: 1) biophysical environments primarily free from modern human manipulation and impact; 2) personal experiences in natural environments relatively free from the encumbrances and signs of modern society; and 3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature.

All four federal land agencies with wilderness stewardship responsibilities have worked together to develop a national interagency monitoring framework and technical guides for wilderness character

monitoring (Landres and others 2015). The associated monitoring technical guide was not complete when indicators were selected for forest plan monitoring in 2016, so BTNF selected three interim indicators. The monitoring guide is due for publication in 2019 and BTNF is scheduled to conduct the baseline monitoring of wilderness character in 2019. For future monitoring periods, it is recommended that the three current indicators be dropped in favor of two new indicators that are based upon the framework's monitoring guide and better address the monitoring question:

WLDN-01-01: Trend in Wilderness Character

WLDN-01-02: Wilderness Stewardship Performance score

Indicator WLDN-01-01: Extent to which fire is playing its natural role

Summary of methodology

This indicator monitors actions taken to control or manipulate natural fire (i.e. fire ignited by lightning) within BTNF's three wildernesses: Bridger, Gros Venture and Teton. Data were compiled from the Wildland Fire Decision Support System (WFDSS), Teton Interagency Web Archive, and one of the Forest Service's databases—the Forest Activity Tracking System (FACTS). FACTS is a part of the Forest Service's the Natural Resource Manager (NRM) system; information about these databases is available at http://fsweb.nrm.fs.fed.us/.

Monitoring results

From 2013-2018, there have been a total of 717 natural ignitions in BTNF wildernesses. Of these, only 75% were allowed to burn without human manipulation (i.e. monitoring response) and only 12% (2 fires) received a full suppression response within wilderness (i.e. active human interference). In addition to these documented fires, there are likely other small fires that start in wilderness, are not suppressed, and burn out before they are reported.

Table 24. Unplanned ignitions and management responses in Bridger, Teton and Gros Ventre Wilderness 2013-2018

Year	Fire Name	Wilderness	Management Response	Acres	Comments
2018	Yellow Mountain	Teton	Monitor	516	No holding actions
	Tepee	Gros Ventre	Suppression	1	Perimeter control
2017	Spider	Bridger	Monitor	7	No holding actions
2016	Gorge	Bridger	Monitor	175	No holding actions
	Berry	Teton	Complex mgmt. ranging from full perimeter control to monitor	1,733	Started in Grand Teton Natl. Park and moved onto the Forest and the Teton Wilderness. Acres shown are those that burned in the Wilderness
	Sheep Mt	Gros Ventre	Monitor	0.25	No holding actions
	Deer Ridge	Gros Ventre	Monitor	2	Deer Ridge fire later burned over by Cliff Creek
	Cliff Creek	Gros Ventre	Complex mgmt. ranging from full perimeter control to monitor	2,834	Acres shown are the portion that burned within the Gros Ventre Wilderness. Majority of the fire burned in the Shoal Creek WSA
	Highline	Gros Ventre	Monitor	0.2	No holding actions
	Woods Canyon	Gros Ventre	Suppression	0.25	Just inside Wilderness Boundary , Cache Creek Drainage
2015	Boulder Creek	Bridger	Monitor	0.1	Just inside wilderness Boundary
2014	None				

2013	Kendall	Bridger	Monitor	755	All within Bridger Wilderness
	Green	Bridger	Modified Action	470	Burned into Bridger Wilderness
	Enos	Teton	Monitor	1	
	Horseshoe	Bridger	Monitor	0.1	
	Snake	Teton	Monitor	120	Started in Yellowstone burned along boundary of Teton Wilderness
	Star	Bridger	Monitor	0.1	

Discussion and findings

Wilderness is meant to be essentially free from the intentional actions of modern human control or manipulation. BTNF has a long history of progressive fire management that recognizes the value of natural fire in achieving ecological and management benefits. All three Wildernesses are covered by Wilderness Fire Plans with the Teton Wilderness Fire Plan dating back to 1976—one of the first approved wilderness fire plans in the nation. Fire management is exceedingly complex with local, regional and national factors all influencing decisions about the appropriate response to an individual fire start. Nonetheless, the high percentage of fires allowed to burn without human manipulation within wilderness suggests that, in general, BTNF is meeting the Forest plan objectives.

Adaptive management considerations

No changes to the Forest Plan or management activities are warranted. For proposed monitoring program changes, see discussion of indicator changes under Question WLDN-01.

Indicator WLDN-01-02: Campsite condition and trail encounters

Summary of methodology

This indicator assesses the number of recreation sites and their condition, based on the national minimum protocol for recreation site monitoring in wilderness. A ‘recreation site’ is defined as a place where visible impacts to vegetation or soil are documented as a result of recreational use. The ‘trail encounter’ measure assesses the number of other groups (or people) seen per standardized unit of time (typically an 8-hour day) while in wilderness during the primary use season. This measure is part of the national minimum protocol for monitoring solitude in wilderness. Data regarding campsites and trail encounters is currently stored in excel spreadsheets or on paper copies on BTNF.

Monitoring results

Teton Wilderness

Campsite condition

An inventory of campsite conditions in portions of the Teton Wilderness was completed in the early 1990s but systematic monitoring using a defined protocol (consistent with Gros Ventre Wilderness) did not begin until 2017. The 2017 survey area included the South Buffalo Fork, the Soda Fork, and Nowlin Meadows. A total of 38 sites were monitored in this area with 35 sites recorded as active. The average campsite impact rating for active sites was 1.74 on a 5 point scale. The average impact rating for the stock holding areas associated with the campsite was 8.22 on a 12 point scale.

Trail encounters

Trail Encounters are not currently monitored pending development of a consistent protocol that meets the national minimum requirement for solitude monitoring.

Gros Ventre Wilderness

Campsite condition

Inventory of campsites in the Gros Ventre Wilderness is complete and systematic monitoring of sites has occurred since 2004. The campsite monitoring protocol divides the Wilderness into 4 quadrants with one quadrant monitored every five years. Three rounds of monitoring have occurred with 439 sites tracked in the inventory. Of those sites, 237 were recorded as active in the last monitoring cycle (54% of total sites). The average campsite impact rating for active sites was 1.77 on a 5 point scale. The average impact rating for the stock holding areas associated with campsites was 5.6 on a 12 point scale.

Trail encounters

Trail encounters have been monitored since 1991 by wilderness rangers and trail crew members. However, this monitoring has been guided more by where crews are working on trail projects or campsite monitoring than by a systematic protocol. Analysis of data collected to date suggests that there is too much variability in where information is collected to be able to identify trends with any confidence. Preliminary information for recent years is shown in the table below.

Table 25. Trail encounters, Gros Ventre Wilderness, 2010-2018

Year	Number of hikers	Number of horse riders	Total encounters[1]	Encounters/day
2010	194	228	422	3.8
2011	130	90	220	2.8
2012	216	85	301	3.4
2013	256	155	411	4.8
2014	418	134	552	5.0
2017 (Eclipse)	563	27	590	9.1
2018	240	76	316	4.0
% of Total Visitors	72%	28%		

[1]Hours spent on patrol varies annually, so total encounters cannot be compared across years

Bridger Wilderness

Campsite condition

Systematic campsite condition monitoring has been occurring within the Bridger Wilderness since 1992, when a monitoring protocol was established using a modified Frissel Condition Class rating. Because the Bridger Wilderness contains over 2,300 lakes and ponds, as well as multiple high alpine meadows, it isn't possible to monitor all campsites. For this reason, 100 lakes were selected in 1992 within DFC 6A-6D to provide representative information and trends regarding campsite conditions and adherence to setback rules (200 feet for lakes, and 100 feet for streams and Forest System Trails). Monitoring of campsite conditions and adherence to setback regulations within the Bridger Wilderness has occurred at 20 selected lakes each year, with repeat monitoring at these locations every five years, resulting in six sets of monitoring data for 100 selected lakes from 1992 to present. Campsite condition monitoring over the past 16 years has revealed that a high percentage of campsites monitored each year don't meet setback regulations established for this wilderness over 30 years ago. Data for campsite conditions by DFC 6A-6D at these 100 lakes is documented in spreadsheet format, but thorough analysis of this data to identify trends over the past 25+ years has not been completed. Percentage of campsites not meeting setback regulations is also documented but not analyzed for this report.

Table 26. Campsite Condition Monitoring, Bridger Wilderness, 2013-2017

Bridger Campsite Monitoring	2013	2014	2015	2016	2017	5-Year Totals
Total Lakes Monitored in DFC 6A	4	3	2	4	4	17

Bridger Campsite Monitoring	2013	2014	2015	2016	2017	5-Year Totals
Total Lakes Monitored in DFC 6B	6	8	8	8	7	37
Total Lakes Monitored in DFC 6C	7	8	7	7	8	37
Total Lakes Monitored in DFC 6D	3	1	3	1	1	9
Total Lakes Monitored DFC 6A-6D	20	20	20	20	20	100
Total # Campsites Monitored	234	239	241	248	286	1,248
Average Frissel Rating	1.8	1.9	1.8	2.2	1.7	
5 Year Avg. Frissel Rating	1.9					

Trail encounters

Wilderness Rangers monitor and report trail encounters by DFC within the Bridger Wilderness on daily hitch reports. Although this data has not been thoroughly analyzed for the majority of the wilderness, trail encounters in the Pole Creek/Seneca Lake Trail/Island Lake corridor indicate that trail encounters in this trail corridor consistently exceed Forest Plan trail encounter standards during the peak July and August season. The Big Sandy Trail, which provides primary access to the Cirque of the Towers within the adjacent Popo Agie Wilderness on the Shoshone National Forest, also has trail encounters exceeding Forest Plan standards in July and August. Trailhead parking at the Big Sandy Trailhead, designed for 60 vehicles, has had over 300 vehicles parked in peak season of use over the past several years. Total visitation information has also been collected annually since 1964 using voluntary trailhead registers, outfitter guide use reports, and visitor permits for organized group use and overnight stock users. However this data has not been analyzed since 2002 due to limited resources. Like the Gros Ventre Wilderness, trail encounter monitoring has not been conducted using a systematic protocol that meets the national minimum protocol for solitude monitoring. Compliance with voluntary trailhead registration, estimated at 70% in the 1990s, has declined and current compliance is unknown. Hiker and stock estimates are 75% hiker and 25% horse use, and it is estimated that 80% of visitor use is from out-of-state, with approximately 3% from out of country.

Table 27. Visitation estimates, Bridger Wilderness, 1991-2000

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
# of visitors	29,592	25,049	28,204	28,910	29,195	32,570	29,985	30,345	25,072	28,337

Discussion and findings

Monitoring campsite condition and trail encounters provides a tangible way to assess the trend in opportunities for people to immerse themselves in nature away from the sounds and sights of modern civilization. Thresholds for acceptable campsite condition and for the acceptable number of trail encounters were established in the 1990 Forest Plan and refined in the 1994 Wilderness Action Plans. In the Teton Wilderness, campsite conditions are acceptable but some stock holding areas need attention, particularly in the Yellowstone Meadows area. Based on field observations, trail encounters are believed to be within established thresholds. Teton Wilderness is considered one of the premier horse packing wildernesses in the National System; more than 50% of use is stock-based, although hiking/backpacking use is increasing as the popularity of the Continental Divide National Scenic Trail grows. In the Gros Ventre Wilderness, monitoring suggests that there is a decrease in the number of active campsites and campsite condition has improved. Trail encounters generally are within established thresholds, although there are a few days when popular day hike destinations near Jackson exceed the threshold of encountering no more than 20 groups per day (e.g. Goodwin Lake/Jackson Peak, Sleeping Indian). In the Bridger Wilderness, campsite conditions vary by DFC but overall campsite condition trends are meeting Forest Plan standards. However, a high percentage of campsites are not meeting setback regulations (200 feet from lakes and 100 feet from streams and Forest System Trails). There are sanitation concerns in the Island Lake/Titcomb Basin areas that require attention. Visitation data suggests that popular locations in the Bridger Wilderness have been consistently exceeding established thresholds for trail encounters in July, August, and September. Despite

management actions (e.g. Pole Creek/Seneca Lake/Titcomb Basin trails and Big Sandy trail), this doesn't appear to be improving.

Monitoring campsite condition and trail encounters are labor intensive tasks. The Teton and Bridger Wilderness programs currently lack sufficient capacity to adequately monitor key indicators in accordance with national protocols. New electronic technology is being tested to improve the efficiency of data collection and results from 2018 are encouraging. The rollout of comprehensive wilderness character monitoring in 2019 will require concentrated effort notability associated with data analysis but should result in more focused and consistent data for all three wildernesses.

Adaptive management considerations

Visitor use planning is an important need to address growing visitor use and the associated impacts, particularly for the Bridger Wilderness. Such planning will need to be closely coordinated with the Shoshone National Forest. For proposed monitoring program changes, see discussion of indicator changes under Question WLDN-01.

Indicator WLDN-01-03: Authorized motorized and mechanized entry

Summary of methodology

The Forest Service requires every wilderness data steward to annually report the number of authorizations for mechanized use, which is stored within the INFRA database. INFRA is a part of the Forest Service's the Natural Resource Manager (NRM) system; information about these databases is available at http://fsweb.nrm.fs.fed.us/.

Monitoring results

Since 2009, the Teton Wilderness has averaged 4.4 mechanized authorizations annually, while the Gros Ventre wilderness has averaged 1.4 authorizations, and the Bridger Wilderness has averaged 5.0 authorizations (TABLE 28). The vast majority of authorizations are emergencies involving search and rescue missions rather than fire operations (89% in the Teton Wilderness, 90% in the Bridger Wilderness and 53% in the Gros Ventre Wilderness). Significant injuries in the Teton Wilderness often involve horse-related accidents whereas injuries in the Bridger Wilderness often relate to climbing accidents. Of the six administrative authorizations in the Teton Wilderness, half involved grizzly bear investigations.

Table 28. Number of documented authorizations for mechanized use in wilderness, 2009-2018

	Teton Wilderness	Gros Ventre Wilderness	Bridger Wilderness
2009	3 emergency, 1 admin	1 admin	6 emergency
2010	3 emergency	2 emergency	3 emergency
2011	4 emergency, 1 admin	0	2 emergency
2012	5 emergency	1 emergency	8 emergency
2013	3 emergency, 2 admin	2 emergency	5 emergency
2014	3 emergency	1 emergency	8 emergency
2015	1 emergency, 1 admin	2 emergency	2 emergency
2016	8 emergency	2 emergency	9 emergency
2017	2 emergency, 1 admin	2 emergency	2 emergency
2018	6 emergency	1 emergency	5 emergency
Average	4.4	1.4	5.0

Discussion and findings

The Wilderness Act, along with Forest Service regulations and policy, restrict the use of motorized equipment and mechanical transport in wilderness, requiring authorizations at various levels of the agency when such use is deemed the minimum necessary to administer the wilderness. Emergency authorizations are typically related to fire response or search and rescue missions while administrative authorizations are often related to wildlife issues. Most motorized use in wilderness on BTNF is to support search and rescue. County sheriffs are responsible for search and rescue missions; cooperative agreements are in place between the Forest Service and both Teton and Sublette County Sheriff's Department outlining procedures for search and rescue in wilderness. The rigorous agency approval process for administrative use of motorized equipment keeps authorizations low and that trend is likely will continue. However, with increasing visitor use, there will likely be more people who not properly prepared for remote wilderness travel and the number of search and rescue missions and emergency requests related to bears will likely increase.

With increasing visitor use, future management will need to focus on providing information to help prepare visitors for wilderness travel (e.g. Teton County Search and Rescue Backcountry Zero campaign, outfitter education) and working proactively with State and Federal wildlife biologists to address increasingly complex wildlife and fish issues so that mechanized use does not increase.

Adaptive management considerations

For proposed monitoring program changes, see discussion of indicator changes under Question WLDN-01. No changes to the Forest Plan and management activities are warranted.

Question EVS-01: What stressors are impacting the plan area?

Indicator EVS-01-01: Extent of insect and disease infestation

Summary of methodology

Insect and Disease (IDS) dataset is a compilation of forest insect, disease and abiotic damage mapped by aerial detection surveys on forested areas in the United States. State and Private Forestry division of the USDA Forest Service publishes insect and disease survey maps; BTNF Aerial Detection Survey Maps can be found at: https://www.fs.usda.gov/detailfull/r4/forest-grasslandhealth/?cid=fseprd571329&width=full

Monitoring Results

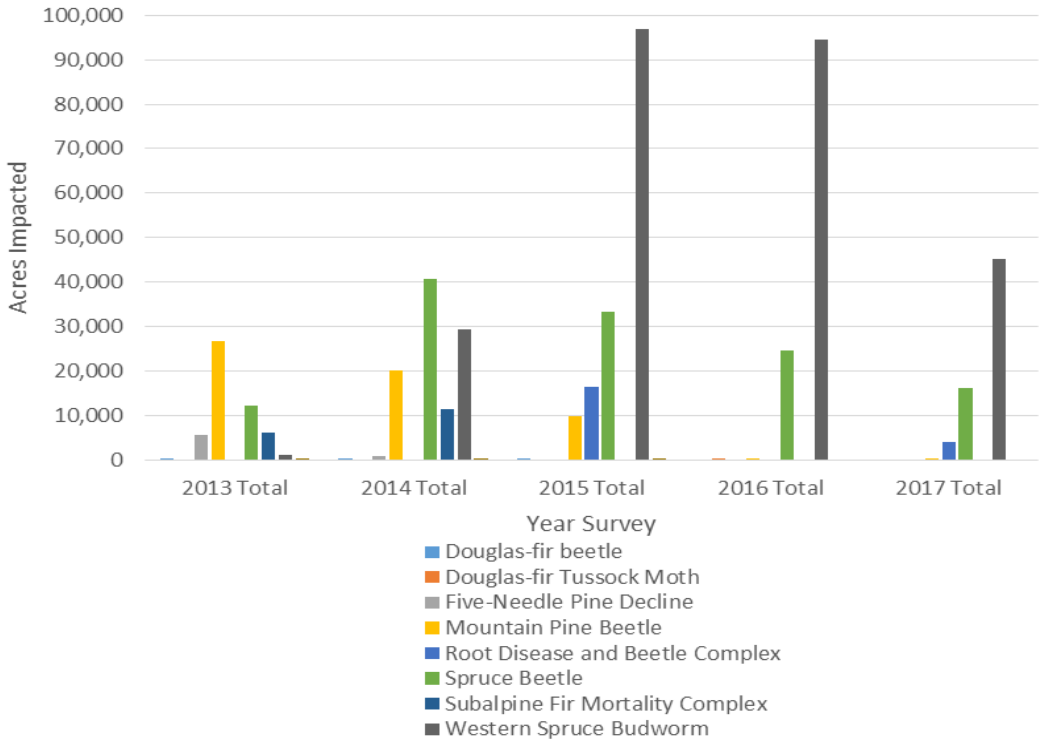

Figure 35. Acres impacted by insect infestation and disease, 2013-2017

The following three biotic stressors represent the largest level of infestation and resulting mortality on BTNF: mountain pine beetle (MPB), spruce beetle, and western spruce budworm.

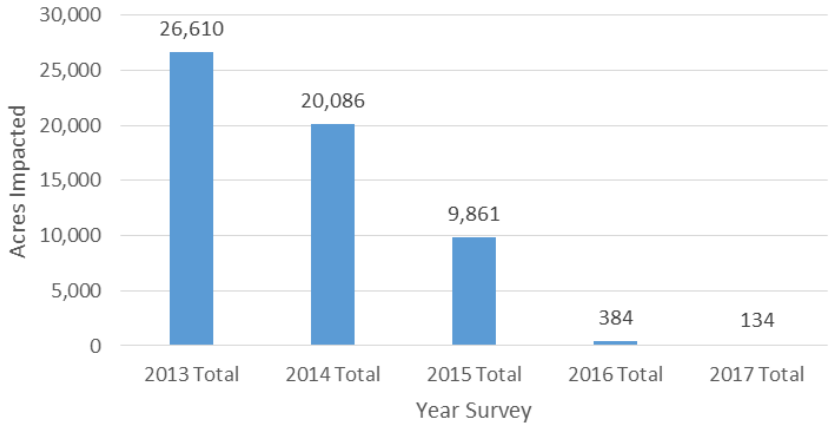

Figure 36. Acres infested by mountain pine beetle, 2013-2017

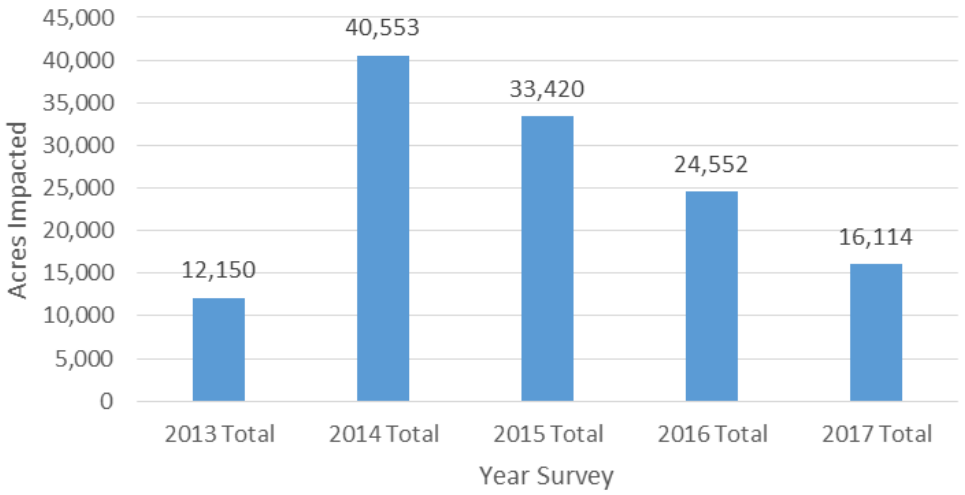

Figure 37. Acres infested by spruce beetle, 2013-2017

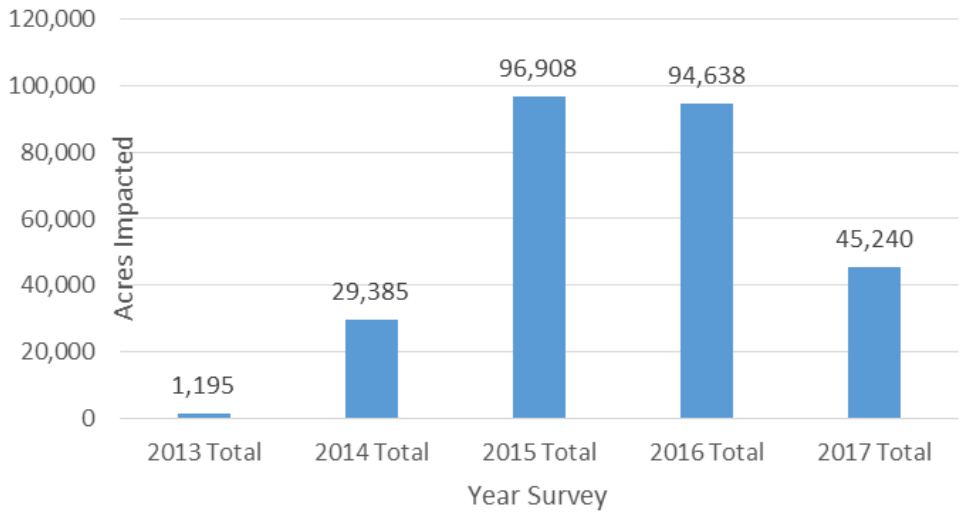

Figure 38. Acres infested by western spruce budworm, 2013-2017

Discussion and findings

Mountain pine beetle, spruce beetle and western spruce budworm

The amount of acres infested by mountain pine beetle, spruce beetle and western spruce budworm all declined since 2015 and it appears that the peak level of infestation for these three stressors may have passed. (FIGURE 36, FIGURE 37, FIGURE 38). On BTNF, MBP infestations peaked in 2009-2010 (FIGURE 36). According to forest health and protection specialists, this current cycle of MPB epidemic has likely ended in Wyoming. The resultant tree mortality to lodgepole pine stands was extensive.

Unlike MBP epidemic, which peaked in 2009, spruce beetle infestations have fluctuated (FIGURE 37). The most recent spike in spruce beetle infestations to BTNF spruce and mixed conifer stands reached their peak in 2014 and are currently on the decline; however, the mortality from the peak of these infestations heavily impacted mature, higher elevation, Engelmann spruce stands. Overall for western Wyoming, over 700,000 acres have been affected by spruce beetle since 1996, leaving large densities of standing dead spruce trees in higher elevations.

Similarly, Western spruce budworm has had large impacts in western Wyoming forests with increasing health challenges to the spruce-fir, Douglas fir, and mixed conifer stands on BTNF (FIGURE 38). In 2015 and 2016, the largest number of acres were impacted by these defoliators. Larval feeding can decrease growth, kill the tops of trees, or kill trees outright if heavy defoliation occurs across multiple years. Defoliation of large areas can degrade the scenic character of forested areas.

These recent epidemics have left large swaths of tree mortality which presents significant management challenges, namely increased hazardous fuel loads and degrading wood fiber that rapidly decreases in commercial value.

Additional stressors

Although not presenting a significant acreage impact on BTNF, there are two additional stressors that have substantial ecological and forest management impacts: white pine blister rust (WPBR) and dwarf Mistletoes. WPBR detections are increasing in western Wyoming. Western Wyoming is notorious for periodic episodes on high white pine blister rust occurrence. Whitebark pine (WBP) stands do not make up a large portion of BTNF forests; however, WBP are an important component of high elevation forests and are important to many wildlife species.

As for dwarf mistletoe, it consists of several species of native parasitic plants locally common in BTNF lodgepole pine and Douglas fir stands. The pathogens can slow growth, deform, and eventually kill trees. They are persistent and spread slowly within and adjacent to trees by exploding berries that shoot sticky seeds. Impacts can be severe on young trees growing adjacent to infected trees. Although not easily detected through aerial survey, field reports from BTNF timber staff suggest that many of the younger, overstocked, lodgepole pine stands on BTNF are currently infested with dwarf mistletoe.

Addressing stressors through management activities

Current management activities are working to restore forested stands to a healthy, and functioning conditions. BTNF conducts salvage sale operations to remove dead and dying timber. This limits the loss of commercial timber value, reduces fuel loads that could influence severity of wildfire and reduces stand densities that help to limit the spread of insect and disease infestations. Implementation of a variety of silvicultural treatments on BTNF that are reduces fuel continuity, restores stands to a healthy cohort of trees, and increases landscape diversity that, in turn, will help reduce future spread of insect and disease infestations. And lastly, forest health projects that include spraying insecticide and pheromone repellent treatments, thinning, and pruning are utilized to control spread of insect and protect legacy trees in developed recreation sites and highly values whitebark pine stands.

Adaptive Management Considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities is warranted.

Indicator EVS-01-02: Amount of snowpack and spring runoff

Summary of methodology

Snowpack data were from SNOTEL stations, which are managed by Natural Resource Conservation Service (NRCS) and are publically available at https://www.wcc.nrcs.usda.gov/basin.html. Snow water equivalent (SWE) is the quantity of water contained within the snowpack. Percent of median SWE is the percent of the value lying at midpoint in a frequency distribution of measured SE values. Medians are based on values from 1981 through 2010. Steam discharge data were from United States Geological Survey (USGS) stream gauges and are publically available at https://waterdata.usgs.gov/wy/nwis/rt. Provisional data were used for a portion of mean stream

discharge calculations. Data are presented in water years, which begins October 1st and ends September 30th.

New science or information:
The Intermountain Region published a Climate Change Vulnerability Assessment in 2018 that discusses the most recent information on climate change science and how it is being adapted into management of National Forest System Lands (Halofsky and others 2018).

Monitoring results

Table 29. Percent of median snow water equivalent, 2017-2018

Basin	Water Year	Dec 1	Jan 1	Feb 1	Mar 1	Apr 1	May 1
Pacific Creek	2017	76	149	145	182	168	194
	2018	177	132	123	124	125	146
Buffalo Fork	2017	72	125	137	153	137	149
	2018	171	148	127	130	136	150
Gros Ventre	2017	59	125	126	164	150	167
	2018	173	130	114	119	123	132
Hoback	2017	63	153	158	197	175	221
	2018	193	127	106	113	124	129
Greys River	2017	73	130	143	172	156	199
	2018	149	120	118	123	123	138
Salt River	2017	60	109	133	151	129	200
	2018	118	100	100	98	104	112
Snake	2017	64	124	131	157	144	170
	2018	154	114	110	114	118	124
Sweetwater	2017	25	145	195	229	196	218
	2018	110	83	75	80	82	65
Upper Green at	2017	45	135	146	195	169	207
	2018	162	124	111	121	122	116
Upper Green-	2017	72	141	158	196	173	193
	2018	152	122	116	131	127	130
Newfork River	2017	48	120	94	183	153	189
	2018	116	111	108	109	106	84
Big Sandy	2017	58	147	177	201	156	183
	2018	87	83	84	91	99	72
Green above Fotenelle	2017	60	136	146	192	168	196
	2018	146	120	112	120	121	118
Hams Fork	2017	53	120	161	182	160	201
	2018	93	78	88	87	92	86
Smiths and	2017	55	123	168	185	160	200
	2018	94	73	91	85	95	81

Table 30. Percent of mean stream discharge, 2017-2018

USGS Stream Gauge	Year	Apr	May	Jun	Jul	Aug	Sep	Oct
Buffalo Fork AB Lava Creek	2017	165%	169%	180%	161%	140%	145%	143%
	2018	101%	228%	136%	106%	106%	104%	94%
Gros Ventre at Kelly	2017	148%	142%	187%	162%	151%	155%	139%
	2018	182%	228%	148%	117%	133%	128%	126%
Snake near Alpine	2017	244%	160%	181%	139%	100%	119%	142%
	2018	180%	212%	135%	91%	77%	92%	96%
Greys River	2017	216%	157%	159%	133%	136%	142%	133%
	2018	173%	177%	103%	86%	104%	105%	111%
Salt River AB reservoir near Etna	2017	229%	177%	172%	131%	122%	126%	125%
	2018	132%	119%	94%	80%	94%	89%	96%
Sweetwater River	2017	223%	227%	227%	176%	175%	220%	132%
	2018	53%	69%	51%	37%	33%	54%	58%
Green River at Warren Bridge	2017	133%	188%	215%	157%	127%	148%	139%

USGS Stream Gauge	Year	Apr	May	Jun	Jul	Aug	Sep	Oct
	2018	144%	202%	137%	85%	81%	73%	99%
Pine Creek AB Fremont	2017	145%	114%	176%	192%	172%	158%	152%
	2018	147%	197%	131%	76%	82%	63%	No
New Fork Near Big Piney	2017	257%	179%	225%	187%	122%	152%	165%
	2018	98%	218%	115%	59%	70%	84%	80%
Green River near LaBarge	2017	242%	229%	229%	178%	125%	140%	159%
	2018	119%	209%	126%	74%	70%	61%	84%
Smith's Fork near Border	2017	273%	186%	174%	134%	130%	128%	118%
	2018	124%	143%	71%	70%	83%	90%	97%
Hams Fork Below Pole Creek	2017	255%	186%	197%	141%	115%	143%	118%
	2018	96%	87%	41%	37%	49%	54%	78%

Discussion and findings

Although long term climate data throughout the Intermountain Region indicates a drying trend with decreased snowpack and decreased stream discharge (Halofsky and others 2018); overall snowpack and stream discharge on BTNF remained at average to above average for 2017-2018 (TABLE 29, TABLE 30). In 2017, SWE values of monthly snowfall were generally average to above average for all basins on BTNF. Percent of median values for SWE for 2017 started out low (below 80%) but quickly increased to well over 100% of median values during January. Snow pack in 2017 extended well into the summer months with percent of median SWE for the month of May exceeding 200% for some basins.

In 2018, with the exception of four basins on the southern region of the forest, snowpack was average to above average for BTNF (TABLE 29). The year began with more snow than 2017, with December SWE ranging from 110% to 193% of median for the north regions of BTNF. Above median SWE values held through the remainder of the water year. Basins to the south that received below median SWE included the Sweetwater and Big Sandy basins in the Pinedale Ranger District and the Hams Fork and Smiths and Thomas Forks basins on the Kemmerer Ranger District.

In 2017, stream discharge values were above average for all watersheds on BTNF. Similar to snowpack, 2018 stream discharge was average to above average for northern regions of the forest while southern watersheds tapered off to below average during the later summer months

Data collected as a result of the monitoring plan provide insight regarding short term stressors to the plan area (i.e. stressors on annual forage production). There should be no stress to trees as a result of decreased snowpack and stream discharge during this biennial monitoring period. Long-term data are available and summarized in the Forest Service's Climate Change Vulnerability and Adaptation in the Intermountain Region (Halofsky and others 2018).

Adaptive management considerations

Based upon the long-term trend outlined in (Halofsky and others 2018), there is a need to assess how management activities on BTNF are contributing to climate change and how these might be most effectively addressed, which may result in a need to change the Forest Plan and certain management activities, though no specific recommendations are being made at this time. No changes to monitoring program are warranted.

Indicator EVS-01-03: Extent of invasive species

Summary of methodology

Total infested acreage and cheatgrass infested acreage were derived from BTNF corporate GIS, which includes data from annual treatment and inventory reports submitted by Teton, Sublette, and Lincoln Counties Weed and Pest agencies and inventory data collected by BTNF staff and citizen scientists.

Data within the Forest Service's Natural Resource Information System (NRIS) is not accurate. Acreage listed in year ranges (1995-2005, 2006-2017) represent within-range cumulative treatment areas reported and excludes between-year). Total acres infested as of 2018 is corrected for overlap of multiple inventories across year ranges. Spatial information is colored by year range to illustrate potential spread.

Monitoring results

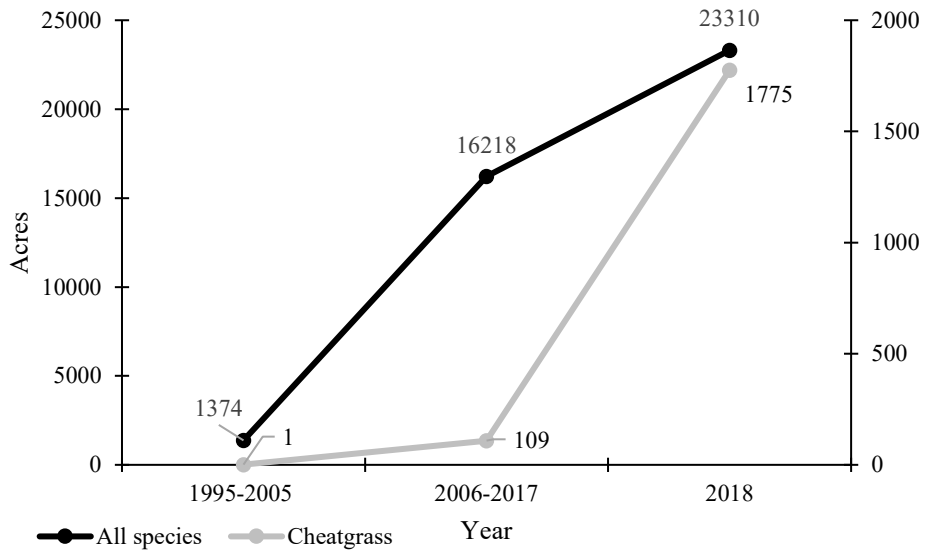

Figure 39. Acres infested by noxious weeds, 1995-2018

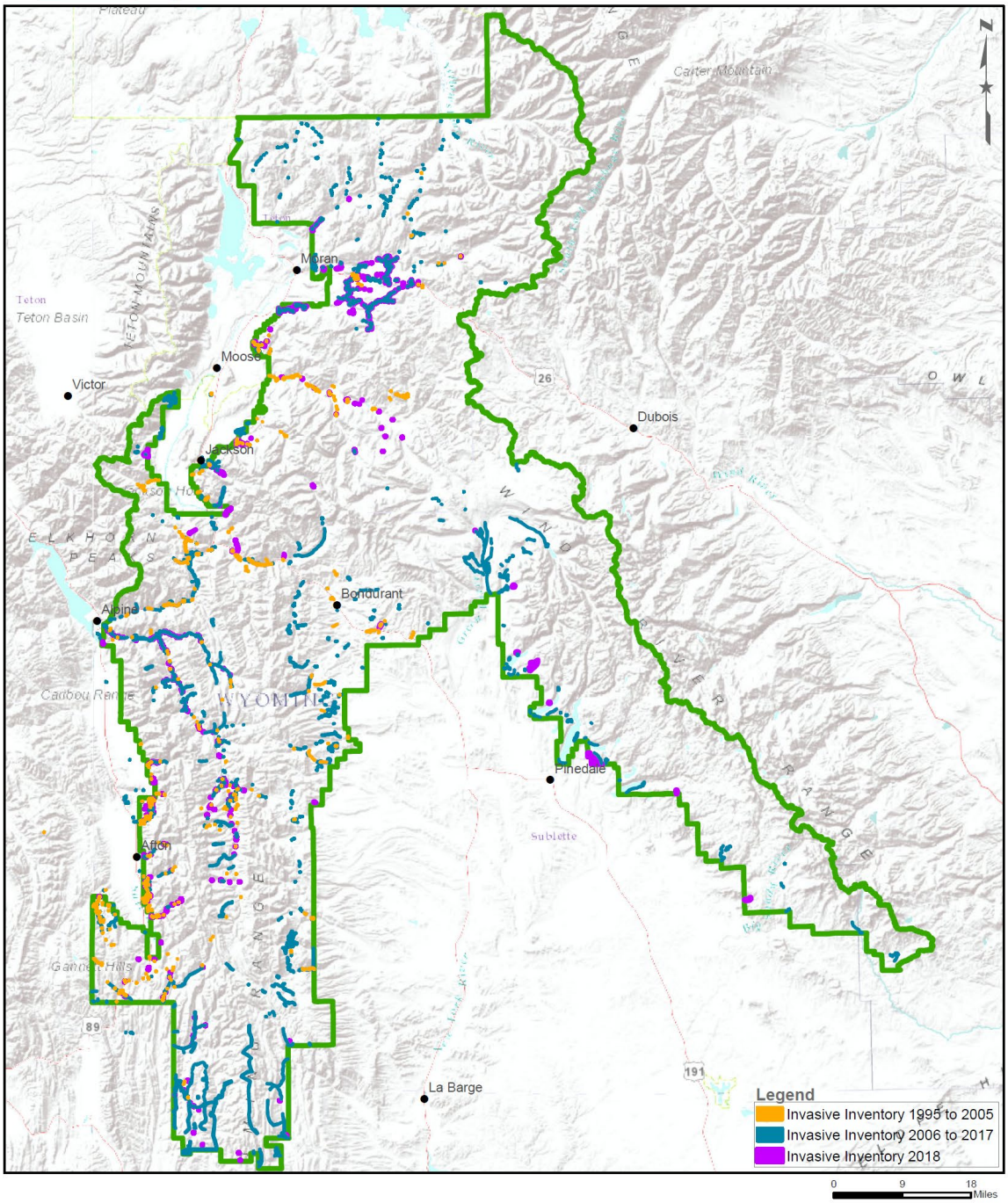

Figure 40. Noxious weed spread, 1995-2018

Discussion and findings

The extent of invasive species is rapidly increasing on BTNF, particularly cheatgrass (FIGURE 39, FIGURE 40). This inference must be tempered, however, with the probability that many infestations went undetected or unreported prior to 2006. The increased acreage is likely at least partially due to improved inventory of existing infestations, rather than expansion of existing infestations and introduction of new ones, particularly for cheatgrass, which likely infested more than one acre prior to 1995 (FIGURE 39). Furthermore, net acreage is likely an overestimation because inventories are total—

rather than net—acres; invasive plant infestations are patchy, with large areas within each inventory that may be uninfested.

Despite some uncertainty about infestation trend due to methodology, it is clear that cheatgrass is expanding on BTNF. Of particular concern is the recent expansion of cheatgrass on south-aspect slopes in the Wind River and Gros Ventre ranges. Widespread invasion cheatgrass in the Intermountain West has drastically altered native plant communities, accelerating fire return intervals and negatively impacts habitat for key species (e.g. greater sage grouse)(Brooks and others 2004; Mack and others 2000). Though previous disturbances such as fire, recreation and grazing may have combined to allow invasive species establishment, climate change is likely a contributing factor in increased vulnerability of south-aspects and low elevation areas to new infestations.

Adaptive management considerations

Efforts are currently underway to improve implementation of existing monitoring protocols. Furthermore, BTNF is currently undertaking a forest-wide invasive management project targeted at providing more management options for invasive plants. Based upon expectations associated with these efforts, no changes to the monitoring program, Forest Plan, or management activities are warranted.

Question ECC-01: Are multiple use opportunities on the Forest contributing to the prosperity of local communities?

Indicator ECC-01-01: Forest visitor numbers

This is a duplicate indicator of RA-02-01 and discussed in that section.

Indicator ECC-01-02: Availability and use of commercial recreation opportunities

This is a duplicate indicator of RA-02-02 and discussed in that section

Indicator ECC-01-03: Availability and use of livestock grazing opportunities

Summary of methodology

Data were derived from the Natural Resource Manager (NRM) database Range Module. Information about these databases is available at http://fsweb.nrm.fs.fed.us/. 'Number of head months permitted' represents the maximum occupancy (livestock numbers and season of use) allowable under current permit provisions. 'Number of head months billed' represents the actual occupancy (livestock numbers and season of use) applied for and authorized in a given grazing season. A head month is the basic unit of occupancy (e.g. one cow/calf, ewe/lamb pair or yearling/cow/ewe for one month) for which the permit holder is charged a grazing fee.

Monitoring results

The number of head months applied for and billed for cattle and horse permits in 2017 was approximately 79% of the number of head-months available under conditions of maximum permitted occupancy (TABLE 31). The number of head months applied for and billed for sheep & goat permits in 2017 was approximately 67% of the number of head-months available under conditions of maximum permitted occupancy (TABLE 31).

Table 31. Active livestock grazing allotments, FY2017

	Number of Active Allotments	Number of Head-months permitted (Maximum Permitted Occupancy)	Number of Head-months billed (Actual Authorized Occupancy)
Cattle & Horse	60	103,096	80,096
Sheep & Goat	35	116,667	78,315

Discussion and findings

Though some of the difference between maximum and billed or authorized head months results from non-use for resource protection (involuntary non-use due to resource issues), the majority is attributable to non-use for the personal convenience of the permittee. With regard to existing permit holders, this is an indication that the number of head months offered exceeds the number of head months desired / consumed.

Interest from livestock producers who are not current permit holders on BTNF allotments has varied over the years, but has not been tracked in reportable form. Some of this interest takes the form of inquiries about temporary accommodation of producers who have run out of forage in their own or rented pastures. Others inquire as to availability of vacant allotments and forage reserves with the intent of receiving authorization under ten-year term-permits.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan, or management activities are warranted.

Indicator ECC-01-04: Amount of timber offered and produced

This is a duplicate indicator of TIM-01-02 and discussed in that section.

Indicator ECC-01-05: Availability and use of firewood and other products for personal use

Summary of methodology

Data on the availability and use of firewood and other non-commercial forest products (such as fence posts and poles) is tracked in the Periodic Timber Sale Accomplishments Report (PTSAR) by quarter for each fiscal year (FY) (October 1 - September 30). PTSAR tracks forest product volumes in various categories, including the regular program funded with appropriations, the Salvage Sale Fund, personal use permits and small commercial sales. Data is reported for five years to show a trend in permits offered. Thousand cubic feet (CCF) and thousand board feet (MBF) are the industry standard units of measure for convertible timber products offered and sold. A cubic foot (ft^3) is a unit of volume of a cube with sides one foot in length whereas a board foot (fbm)—a unit of volume specific to lumber—is a one-foot length of a board one foot wide and one inch thick.

Monitoring results

Table 32. Volumes sold for non-commercial (personal use) forest products, FY13-FY18

Fiscal Year	Non-commercial products thousand board feet (MBF)	Non-commercial products thousand cubic feet (CCF)
FY13	6,352	10,848
FY14	6330	10,805
FY15	5665	9,684
FY16	5506	9,401

FY17	4897	8,364
FY18	4714	8,057

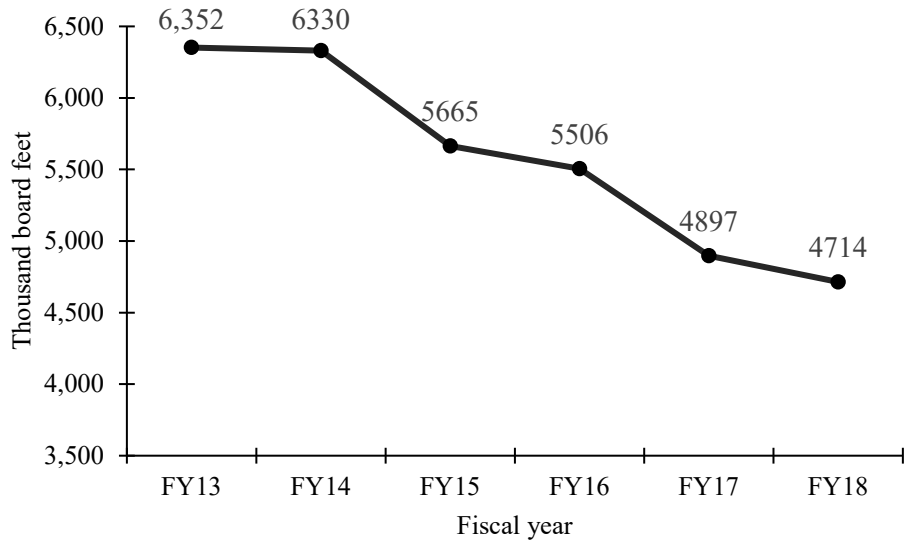

Figure 41. Volume of non-commercial forest products, FY13-FY18

Discussion and findings

BTNF offers permits annually for non-commercial forest products. The monitoring question asks if multiple use opportunities exist on BTNF and how those opportunities contribute to local communities. The current Forest Plan objective is to provide access to an average of 2.5 cords of firewood per firewood-gathering household per year, offering commercial-timber-harvest residual material whenever possible; 2.5 cords converts to approximately 3.2 thousand cubic feet (CCF) per household per year. Per a 3.2 CCF/2.5 cord per household annual goal, BTNF offered enough timber to supply approximately 2,518 households in surrounding communities in FY18. Furthermore, residual wood fiber generated from commercial timber sales is offered to the public for firewood gathering once timber sale units have been completed and accepted as complete by BTNF timber sale administration staff. This has resulted in increased firewood gathering opportunities on the Kemmerer, Big Piney, and Pinedale Ranger Districts. The monitoring results indicate that the Forest Plan goals associated with this indicator are being maintained.

Volumes sold for non-commercial (personal use) forest products is down from FY13 to FY18 by approximately 2,791 CCF (1,683 MBF) (FIGURE 41). While guesses can be made why this decline is occurring, the available data do not provide any specific insight. A more in depth assessment would be needed regarding the economics, scale and drivers of public demand for non-commercial forest products as well as the perceived and actual availability of firewood, fence posts, and fence poles across BTNF.

Adaptive Management Considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities is warranted. If a better understanding of the decline in volume of non-commercial (personal use) forest products is needed, additional assessment is warranted.

Question TIM-01: Is timber harvest occurring in a manner which does not impair the productivity of the land?

Indicator TIM-01-01: Implementation of Best Management Practices during timber harvest and transport

Summary of methodology

The Forest Service has national standards for water quality best management practices (BMP), including required monitoring (USDA Forest Service 2012). An interdisciplinary team (e.g. botany, recreation, timber, wildlife, engineering) assesses BMP for whether prescriptions were implemented as intended and effective in meeting water quality objectives. BMP monitoring is required for approximately seven projects annually on each National Forest. Random project selections in FY 17-18 did not include any timber harvest or transport projects.

Monitoring results

Given the random nature of BMP site selection, formal BMP monitoring was not completed for a timber harvest project in FY 17 or FY18. However, the watershed program staff reviewed the Big Springs Timber Sale harvest and participated in a Timber Sale Administration Exam in FY18. BTNF required BMPs were implemented and buffers around riparian areas during timber harvest were maintained.

Discussion and findings

Implementation of BMPs and adherence to riparian buffers alleviates impacts to water resources. Despite not being documented in a formal evaluation, the results of the Big Springs Timber Sale harvest review suggest that timber harvest is occurring appropriately and effectively on the Bridger Teton National Forest and that Best Management Practices are being implemented. A timber harvest and/or transport project will likely be randomly selected in the near future and results would be reported in following biennial monitoring report.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan, or management activities are warranted.

Indicator TIM-01-02: Amount of timber harvested relative to the Allowable Sale Quantity (ASQ) as specified in BTNF Forest Management Plan (1990)

Summary of methodology

Data on timber volumes sold is tracked in the Periodic Timber Sale Accomplishments Report (PTSAR) by quarter for each fiscal year (FY) (October 1 – September 30). PTSAR tracks forest product volumes in various categories, including appropriated funds, Salvage Sale funds, personal use permits and small commercial sales. In addition, PTSAR reports progress advertisement, bid opening and award, including identification of status such as ongoing, delays, no-bids and re-offered volume. Data are reported for five years to show a trend in sales and volume offered. Thousand cubic feet (CCF) and thousand board feet (MBF) are the industry standard units of measure for convertible timber products offered and sold. A cubic foot (ft^3) is a unit of volume of a cube with sides one foot in length whereas a board foot (fbm)—a unit of volume specific to lumber—is a one-foot length of a board one foot wide and one inch thick.

In the current forest plan, allowable sale quantity (ASQ) estimates the potential commercial timber volume that may be produced on BTNF lands considered suitable for timber harvest. This model-derived quantity has not been updated since the forest plan adoption in 1990.

Monitoring results

Table 33. Timber volumes offered and sold in relation to Allowable Sale Quantity, FY13-FY18.

Fiscal year	Timber offered thousand board feet (MBF)	timber sold as % of timber offered	Timber sold (MBF)	Timber sold as % of ASQ	Forest plan ASQ (MBF)		Timber offered thousand cubic feet (CCF)	Timber sold thousand cubic feet (CCF)
FY13	3,289	100%	3,289	15%	21,300		6,037	6,037
FY14	5,984	68%	4,089	19%	21,300		10,835	7,173
FY15	6,840	100%	6,840	32%	21,300		12,246	12,246
FY16	5,307	100%	5,307	25%	21,300		9,311	9,311
FY17	6,954	100%	6,954	33%	21,300		12,998	12,998
FY18	5,278	59%	3,120	15%	21,300		10,558	6,223

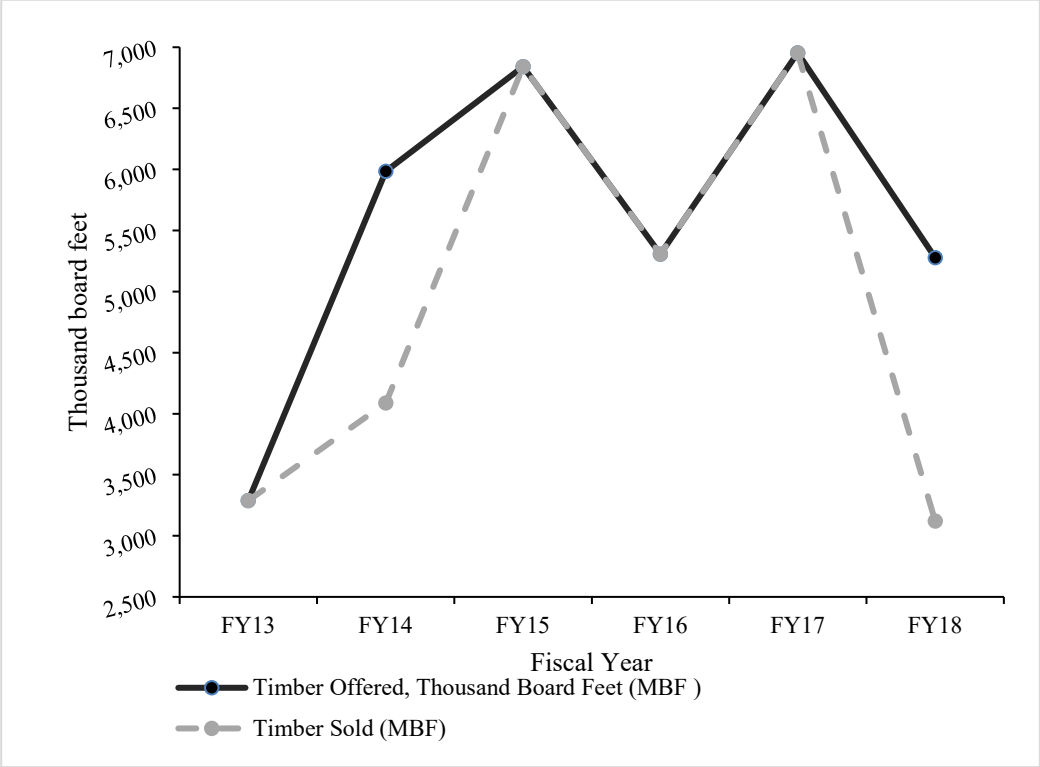

Figure 42. Comparison of timber volumes offered and sold, FY13-FY18

Discussion and findings

Timber volume estimates may vary from the ASQ due to other factors that include, but not limited to the following: timber volume targets assigned by the regional forester that may not be in alignment with the Forest's ASQ; natural disturbances such as wildfires; local industry capacity; and funding. Currently, the regional forester assigns BTNF an annual commercial timber target of approximately 12,000 CCF. This target is currently below BTNF estimated ASQ identified in the Forest Plan.

Success of timber sales sold on BTNF have fluctuated slightly from FY13-FY18 (FIGURE 42). Specifically, FY14 and FY 18 saw several no-bid sales that resulted in BTNF not meeting its annual target for commercial timber sold. However, the general trend between FY13-18 is that timber sale volumes sold have increased. This is likely due to the following factors: 1) increased mortality from insect, disease, and wildfire resulting in increased salvage sale opportunities; 2) neighboring forests producing less timber due to project litigation and Endangered Species Act (ESA) issues; and 3) increased demand from local industry for a variety of timber products that includes fence posts and poles, commercial firewood, commercial house logs, and some saw timber.

Furthermore, the Intermountain Region combines the volumes for non-commercial forest products (i.e. personal use firewood) with the commercial timber volume sold. Reporting on personal use firewood is included in the Economic Contribution to Communities indicator ECC-01-05. Non-commercial forest product volumes, combined with commercial volumes sold under traditional timber sales, has allowed BTNF to meet and exceed annual timber targets and reach target ASQ.

Adaptive management considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Indicator TIM-01-03: Areas of regeneration harvest of timber re-stocked with young trees within five years of final harvest

Summary of methodology

Data are generated from stocking surveys conducted in stands where a regeneration harvest has occurred. A regeneration harvest is defined as a final removal cut within a cycle of silvicultural prescriptions and is utilized to establish a new cohort of trees. Success or failure of adequate stocking in stands treated with a regeneration harvest is determined five years post-harvest and is tracked in one of the Forest Service's corporate databases—the Forest Activity Tracking System (FACTS). FACTS is a part of the Forest Service's the Natural Resource Manager (NRM) system; information about these databases is available at http://fsweb.nrm.fs.fed.us/.

Monitoring Results

Regeneration treatments requiring restocking that have been implemented on BTNF from 2013-2018 include two age coppice cut (with reserves), stand clearcut, stand clearcut (with reserves) and shelterwood removal cut (with leave trees). All stands treated with one of the regeneration prescriptions were certified as successfully meeting regeneration requirements (TABLE 34). All regeneration treatment have all meet adequate restocking within five years of final harvest.

Table 34. Acres of regeneration treatments implemented timber sales, FY13-FY18

Fiscal Year	Total Acres of Regeneration Harvest 5 Years Old	Acres with Adequate Restocking	Acres with Inadequate Restocking	Percent Acres with Inadequate Restocking
FY13	37	37	0	0
FY14	0	0	0	0
FY15	130	130	0	0
FY16	83	83	0	0
FY17	34	34	0	0
FY18	9	9	0	0

Discussion and findings

Stands treated with regeneration harvests have all met adequate stocking requirements within five years post-harvest (TABLE 34). These harvests have primarily occurred within lodgepole pine stands which respond well to disturbance. Soil scarification combined with increased growing space promotes vigorous regeneration of this early successional species. As such, BTNF is meeting Forest Plan objectives for forest regeneration.

Adaptive Management Considerations

Based upon the monitoring results, no changes to the monitoring program, Forest Plan or management activities are warranted.

Conclusion

In general, the monitoring results indicate that BTNF is meeting forest plan objectives, but there are areas where changes may be warranted (TABLE 2, TABLE 35). No urgent need to change the Forest Plan surfaced, but, in a few areas—namely air quality, environmental stressors and vegetation—it was noted that the current Forest Plan direction is outdated and doesn't reflect current understanding of these issues. Given it has been over 30 years since the plan was adopted, this is not surprising. Both existing conditions and best available science have progressed substantially in the last 30 years and to be incorporated in the Forest Plan. Furthermore, there are a few topics—namely climate change, timber harvest feasibility and local timber product demand—where more detailed assessment of the issue is needed before changes to the Forest Plan or management activities can be undertaken.

The monitoring results suggest that, in regards to trails, BTNF is not adequately meeting its Forest Plan objective to provide for user safety and convenience. There is a pressing need to address the low percentage of trails that meet standard. Current appropriated funding levels severely limit our ability to conduct trail maintenance, but BTNF is actively working with partners to reduce the maintenance backlog. There are other aspects of recreation and access where changes to management activities are warranted, including publishing Over Snow Vehicle Use Maps (OSVUM), conducting winter travel planning, modernizing Special Use Permit reporting, conduct campground use planning, improving wilderness campsite conditions and conducting wilderness visitor use planning.

Because 2017-2018 was the first forest plan monitoring period for BTNF under the new monitoring rule, many of the initially proposed monitoring indicators and methodologies did not work as planned or provide adequate information to assess status and trend. Monitoring is an iterative process that often requires initial failures to refine and improve methodologies. BTNF is working to address the needed monitoring changes before the next biennial report and anticipates providing a list of monitoring indicator changes for additional public participation in late 2019.

Table 35. Summary of monitoring evaluation findings for all monitoring questions.

Planning area where change may be warranted	Monitoring area	Monitoring evaluation findings
Forest plan		
	Air Quality	Insufficient direction on air quality goals and objectives Insufficient direction on visibility goals, objectives, standards and guidelines
	Vegetation	Insufficient direction on forest restoration goals, objectives, standards and guidelines
	Environmental Stressors	Insufficient direction on greenhouse gas emission goals, objectives, standards and guidelines

Management activities		
	Vegetation	Increase opportunities to conduct prescribed burning
	Recreation and Access	Reduce trail maintenance backlog Publish Over Snow Vehicle Use Maps (OSVUM) Conduct winter travel planning Modernize Special Use Permit reporting Conduct campground use planning
	Wilderness	Improve campsite conditions Conduct visitor use planning
Assessment		
	Environmental Stressors	Assess forest's contribution to climate change and how to address management activities
	Economic Contribution to Communities	Assess community need for firewood and other products for personal use
	Timber	Assess feasibility of current timber allowable sales quantity (ASQ)
Plan monitoring program		
	Vegetation	Change natural disturbance processes to wildland fire only and address insects and diseases under Environmental Stressors Combine all wildland fire types (human, natural) Drop susceptibility to invasive plant species and address under Environmental Stressors
	Wildlife	Add Canada Lynx surveys and incidental sightings Add North American wolverine surveys and incidental sightings
	Focal Species	Add aquatic organism passage surveys
	Recreation and Access	Drop number of water systems that do not meet requirements Change facility condition index to recreation sites managed to standard Drop guest range visitor numbers and add summer ski use visitor numbers Standardize data collection for recreation sites
	Wild and Scenic Rivers	Standardize data collection for watercraft use Drop campsite and vehicle areas occupancy and replace with miles of river at degraded quality and number of water projects authorized
	Wilderness	Change to trend in wilderness character and wilderness stewardship performance

This monitoring evaluation illustrates the need to embrace adaptive approaches in the management of National Forest Lands. BTNF is attentive to the need to change management strategies based upon monitoring results and emerging science. We will continue to strive to adapt our management and monitoring to best care for the land and serve people.

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