# Supplemental Information to Support the Inyo National Forest Biennial Monitoring Evaluation Report
April 2022

This document includes the results and interpretation of monitoring data collected for fiscal years 2020 and 2021 as part of the Inyo National Forest Plan monitoring program. Methods for the analyses are described in a separate monitoring guide.

This document is organized by seven themes and the monitoring questions associated with each of those themes.

## Contents

# Theme 1: Watershed Conditions

## WS01. To what extent are watersheds in proper functioning condition being maintained, and watersheds in altered or impaired condition being improved?

The indicator associated with this question includes the Watershed Condition Framework Classification.

### *Relevant Plan Components*

WTR-FW-DC -03: Watersheds are fully functioning or trending toward fully functioning and resilient; recover from natural and human disturbances at a rate appropriate with the capability of the site; and have a high degree of hydrologic connectivity laterally across the floodplain and valley bottom and vertically between surface and subsurface flows. Physical (geomorphic, hydrologic) connectivity and associated surface processes (such as runoff, flooding, in-stream flow regime, erosion, and sedimentation) are maintained and restored. Watersheds provide important ecosystem services such as high-quality water, recharge of streams and shallow groundwater, and maintenance of riparian communities. Watersheds sustain long-term soil productivity.

WTR-FW-OBJ-01: Priority watersheds achieve or are moving toward a higher functioning condition class, as defined by the National Watershed Condition Framework within 10 years of plan approval.

### *Key Results*

We did not complete monitoring to answer this question. The last Forestwide watershed condition assessment was completed in 2016 and found that 95 watersheds were in good, 30 watersheds in fair, and 0 in poor condition. Those results will be used as a baseline for comparison when the next assessment is completed.

### *Recommendations*

None

## AE03. What is the status of water quality in national forest waterbodies?

The indicators associated with this question include bacteria levels and 303(d) status.

### *Relevant Plan Components*

WTR-FW-DC-02: Water quality supports state-designated beneficial uses of water and is sustained at a level that retains the biological, physical, and chemical integrity of aquatic systems and benefits the survival, growth, reproduction and migration of native aquatic and riparian species.

### *Key Results*

**Indicator 1: Bacterial levels (E.coli, Fecal coliform and/or Enterococcus)**

- All the monitoring locations that were sampled on the Forest were grouped into three different areas: Mono Lake Basin, Owens River Basin, and the Eastern White Mountains watershed (Figure 1).

- For any given year, the average was taken for all stations in each basin and watershed. These averages where then graphed for the corresponding year.
- Of the fourteen years of data on record, only four years were reported where bacterial levels were greater than or equal to 20cfu/100mL. In 2007, the Eastern White Mountains watershed reported a level of 122 cfu/100mL. However, it's important to note that this reading of 122 cfu/100mL was from only one sample taken for that year. For the Owens River Basin there were three years on record that bacterial levels were at or greater than 20 cfu/100mL. The year 2015 reported a level of 20 cfu/100mL, the year 2013 reported a level of 26.5 cfu/100mL and the year 2011 reported a level of 43 cfu/100mL (Figure 1).
- Of the 99 individual measurements on the Inyo National Forest over 14 years (from 2004-2018), 23 were over 20 cfu/100 mL (the Lahontan Basin standard for fecal coliform. Three of those were over 100 cfu/100, (the standard for fecal coliform elsewhere in California and Nevada). The measures that did not meet standards were often only a one-time measurement on each stream, or fluctuated greatly over the years.
- The interpretation of a clear and definitive trend at a watershed scale is limited because of the inconsistent sampling frequency and small sample sizes. For example, data were sampled during only two years (2012/13) in the Mono Basin and during four years in the Eastern White Mountains watershed. For the latter, only one or two samples were collected each year. Although the Owens River Basin had a longer sampling effort, the sampling effort was inconsistent and many years have data from just one or two samples.

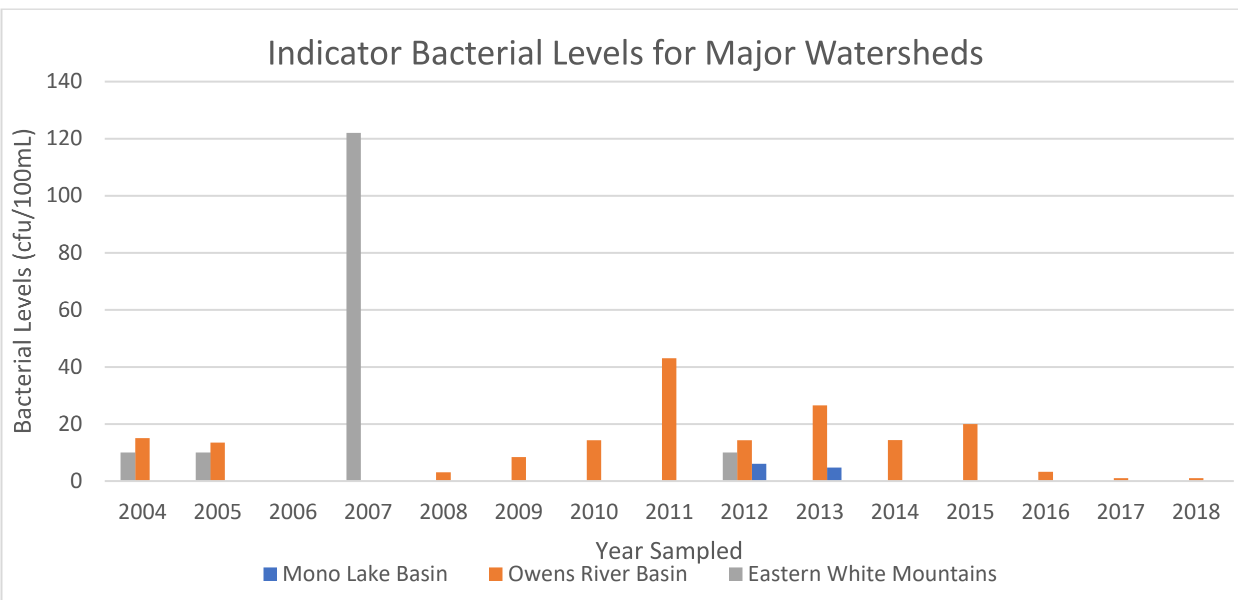



*Figure 1. Graph showing the bacterial levels for E.coli and Fecal coliform in each watershed.*

**Indicator 2: 303(d) Status Waterbodies**

- The most recent report which was compiled in 2018 lists fifteen different streams/rivers and one listed lake for the Forest (Table 1). Figure 2 also shows the location of these waterbodies spatially throughout the Forest.
- This list will establish a baseline moving forward, with each reporting period monitoring if waterbodies are removed or added to the list.

*Table 1. Table showing the list of 303(d) listed waterbodies on the Forest.*

| 303(d) Listed Waterbodies | Waterbody Type |
|---|---|
| Reversed Creek | Stream/River |
| Hot Creek | Stream/River |
| Mill City Tributary | Stream/River |
| Mammoth Creek (3 sections) | Stream/River |
| Convict Creek | Stream/River |
| McGee Creek | Stream/River |
| Hilton Creek | Stream/River |
| Hot Creek Tributary | Stream/River |
| Owens River | Stream/River |
| Rock Creek | Stream/River |
| Pine Creek | Stream/River |
| Horton Creek | Stream/River |
| Lone Pine Creek | Stream/River |
| Horseshoe Meadow Creek | Stream/River |
| Round Valley Creek | Stream/River |
| Mono Lake | Lake |

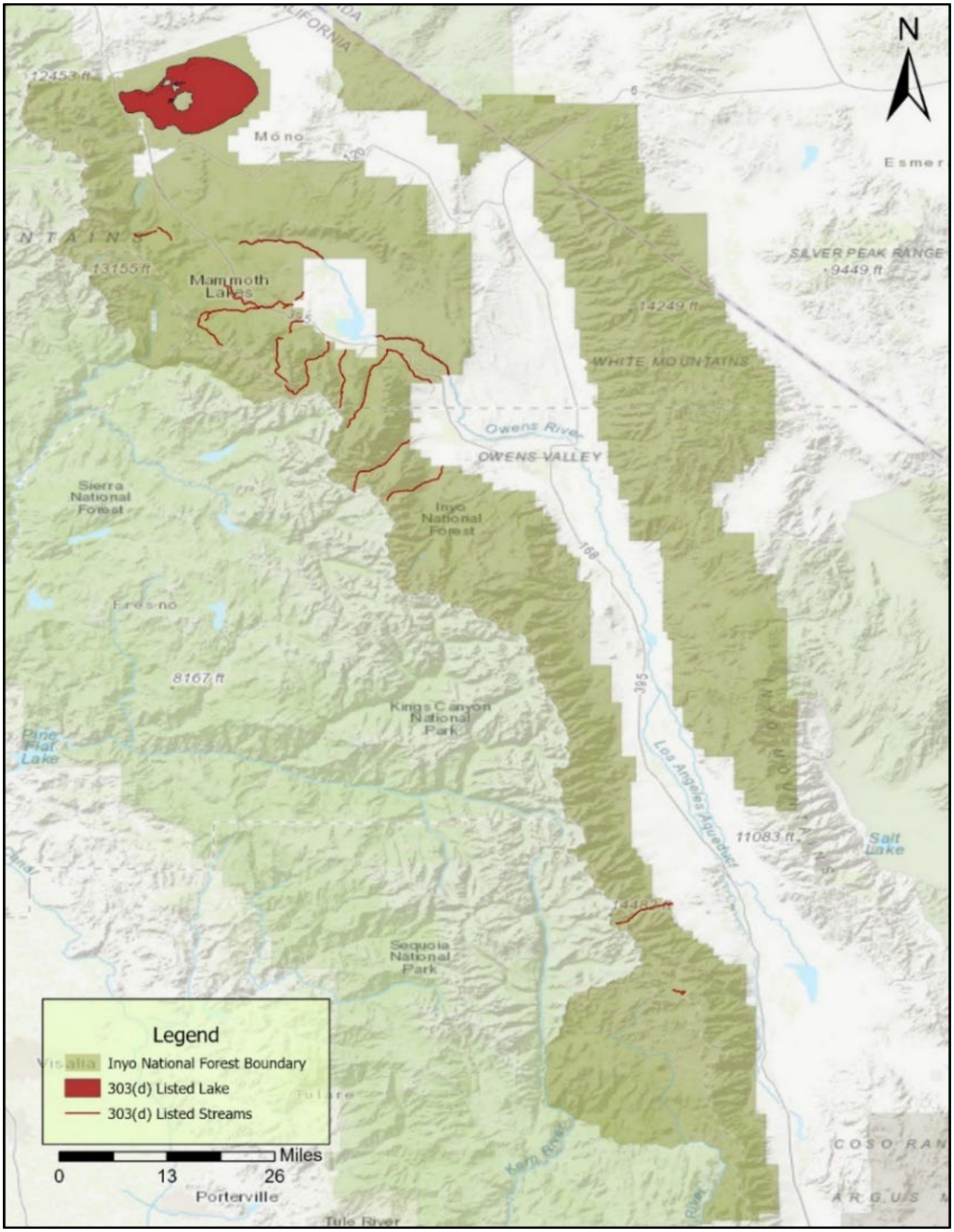



*Figure 2 Map showing the location of the 303(d) listed waterbodies on the Forest.*

**Summary**

Data for both indicators were available through 2018, just prior to the signing of the new Inyo Land Management Plan in 2019. Therefore, water quality monitoring for this first report has produced baseline data and past trends that can be used to compare future changes under the Plan.

Bacteria levels (E. coli and fecal coliform) in specific Inyo waterbodies prior to 2019 appear to be consistent with the Plan desired condition except for a few, isolated peaks. However, data for E. coli and fecal coliform are sporadically collected and in very small sample sizes, making it difficult to discern robust and reliable trends in these variables at the watershed scale. Furthermore, bacterial indicators such as E. coli and fecal coliform are very sensitive to testing. High levels of either bacteria can be very episodic, only showing up if testing is done directly downstream of an active source or if testing is done right after a big runoff producing event.

A total of 16 waterbodies on the Inyo National Forest have a 303(d) listing status. Subsequent monitoring will evaluate changes in these waterbodies.

### *Recommendations*

Based on these results, we are considering the following possible changes:

- Indicator 1: Alter the indicator to be more site-specific (such as one stream) or action-specific (such as grazing or campgrounds) to be able to use bacterial water quality to inform management.

## WS02. To what extent has erosion from temporary and permanent roads and trails affected water quality and soil sustainability in the national forest?

The indicators associated with this question include: (1) road and motorized trail condition, (2) implementation and effectiveness monitoring results from the Best Management Practice Evaluation Program, and (3) number and type of stream crossing and bank stabilization projects.

### *Relevant Plan Components*

WTR-FW-DC-05: Infrastructure (administrative sites, recreation facilities, and roads) has minimal adverse effects to riparian and aquatic resources.

### *Key Results*

**Indicator 1: Soil Conservation Monitoring (motorized road and trail condition)**

This indicator uses the California Off-Highway Motor Vehicle Recreation Division soil conservation evaluation definitions for route-related erosion. In summary, “red” roads and motorized trails have erosion that is severe enough to affect areas outside the road corridor and may cause sedimentation into water bodies. “Yellow” means moderate condition with some erosion, but not reaching a waterway. “Green” indicates that the route has little to no erosion and its erosion control design is performing adequately.

- The majority of roads and motorized trails assessed (>60%) over the past decade were in "green" or "good" condition, with the average being 73% (Figure 3).
- Both "yellow" and "red" roads averaged approximately 20% and 7%, respectively (Table 2).
- This monitoring shows that overall OHV roads throughout the Forest are contributing little sediment to adjacent waterbodies.

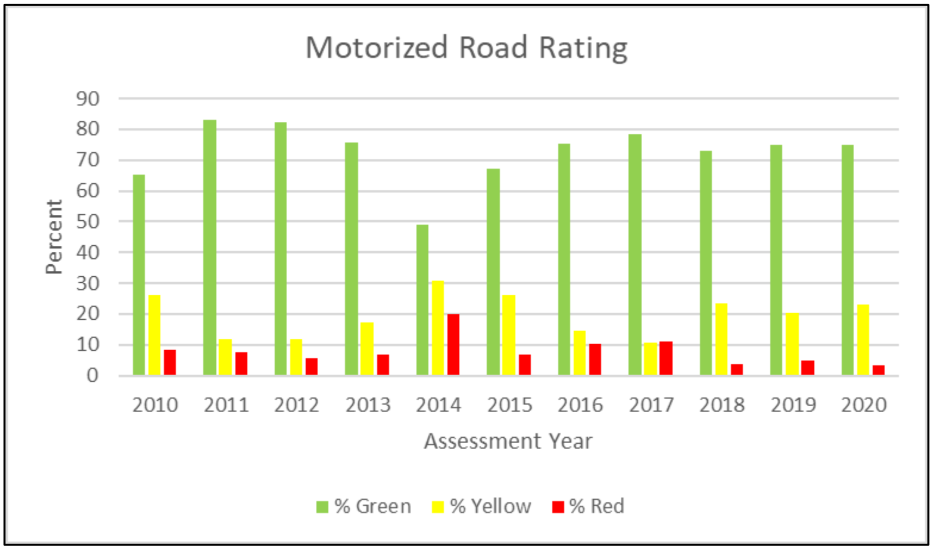



*Figure 3. Ratings of motorized road and trail condition, using the California State OHV Division Trail Condition Evaluation method. Red indicates high levels of erosion and green indicates little to no erosion.*

*Table 2. Number, percent, and the average percent for red, yellow, green roads for each year since 2010.*

| Year Assessed | Total Number of RYG Roads | Number of Green | % Green | Number of Yellow | % Yellow | Number of Red | % Red |
|---|---|---|---|---|---|---|---|
| 2010 | 95 | 62 | 65 | 25 | 26 | 8 | 8 |
| 2011 | 244 | 203 | 83 | 29 | 12 | 19 | 8 |
| 2012 | 793 | 653 | 82 | 94 | 12 | 46 | 6 |
| 2013 | 1115 | 846 | 76 | 191 | 17 | 78 | 7 |
| 2014 | 392 | 192 | 49 | 121 | 31 | 79 | 20 |
| 2015 | 219 | 147 | 67 | 57 | 26 | 15 | 7 |
| 2016 | 391 | 294 | 75 | 57 | 15 | 40 | 10 |
| 2017 | 262 | 205 | 78 | 28 | 11 | 29 | 11 |
| 2018 | 459 | 335 | 73 | 107 | 23 | 17 | 4 |
| 2019 | 421 | 315 | 75 | 86 | 20 | 20 | 5 |
| 2020 | 253 | 190 | 75 | 58 | 23 | 8 | 3 |
| **Average Percent** | | | **73** | | **20** | | **7** |

**Indicator 2: Road and Trail National Best Management Practices (BMP) Evaluations (**Table 3**)**

- Two of the four roads assessed had evidence of erosion occurring and being deposited into the adjacent stream channel. Road 05S01 (Crooked Creek Road) was especially bad, with the road capturing the stream and flowing greater than 1000ft down the road. These issues are still awaiting corrective actions, and the proposed project to remedy the situation was put on hold due to higher priorities and the difficult access to the remote area. The road is planned for improvement, but no date has been set.
- All six trails assessed where in good condition with little to no evidence of detrimental erosion reaching waterbodies.

*Table 3. National Best Management Practice (BMP) evaluations since 2015.*

| Best Management Practice Evaluation | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|
| Recreation D. Trail Operation & Maintenance | | Gardisky Lake Trail | | North Fork Big Pine Creek & Chocolate-Ruwau Loop Trails | Sabrina Basin Trail | McGee Pass Trail & Little Lakes Valley | |
| Road C. Road Operation & Maintenance | 09S102 | 07S101 | | 07S01 | | 05S01 | |

**Indicator 3: Stream Crossing & Bank Stabilization**

- Stream crossing and bank stabilization work has been compiled since 2014 with an estimation of how much streambank has been stabilized in square feet.
- A total of 3,410ft$^2$ of streambank has been stabilized for motorized trails and a total of 370ft$^2$ of streambank has been stabilized for non-motorized trails (Table 4).
- This project work is done when the Forest has the resources to complete this work and varies from year to year. In general, the Forest has been able to repair most stream crossings with known streambank stability issues.

*Table 4. Summary of all the motorized and non-motorized stream crossing and bank stabilization work completed since 2014.*

| Stream Crossing Repair | | |
|---|---|---|
| **Motorized** | **Year Completed** | **Amount of Stream Stabilized (sqft)** |
| 32E303 (Onion Creek) | 2020 | 2000 |
| 04S54 (Birch Creek) | 2019 | 300 |
| 04S54 (Witcher Creek) | 2015 | 300 |
| 32E302 (Sand Canyon Trail) | 2018 | 160 |
| 20S08 (Soda Creek, Monache) | 2015 | 500 |
| 20S03 (Soda Creek, Monache) | 2015 | 100 |
| 20S07A (Monache Creek) | 2015 | 50 |
| Total | | 3410 |
| **Non-Motorized** | | |
| Middle Fork Bishop Creek | 2019 | 120 |
| Hilton Creek Trail Stream Crossing | 2014, 2015 | 200 |
| Lower Lamarck Trail Crossing | 2018 | 50 |
| Total | | 370 |

**Summary**

All three indicators used to assess whether Forest infrastructure, specifically roads and trails, is impacting riparian and aquatic resources shows that there is minimal impact, consistent with the desired condition for the Inyo Plan. Data for indicator 1 shows a consistently high percentage of "green" roads compared to "yellow" and "red" roads over the past 10 years, indicating that there is little erosion occurring on Forest system roads. Data for indicator 2 show that most trails and roads are in good condition, with two roads experiencing some degradation. Data for indicator 3 shows that work is occurring on the Forest to help reduce erosion issues and help the Forest reach its desired condition. Although work is episodic in nature, the Forest stabilized a greater area streambank in 2020, after the Plan was signed, than any other year.

### *Recommendations*

No changes recommended

## PR01. How does soil disturbance differ from pre- and post-activity for timber management?

The indicators associated with this question include soil compaction, displacement, and erosion.

### *Relevant Plan Components*

WTR-FW-DC-04: Soil and vegetation functions in upland and riparian areas are sustained and resilient. Healthy soils provide the base for resilient landscapes and nutritive forage for browsing and grazing animals, and support timber production. Healthy upland and riparian areas support healthy fish and wildlife populations, enhance recreation opportunities, and maintain water quality.

### *Key Results*

Based on past and current monitoring data; projects are adhering to the new Forest plan Desired Conditions, and Standards and Guidelines.

Soil monitoring was completed during summer 2012 (before the new Plan) at six sites that were thinned the previous year. Monitoring was completed in 2021 (after signing the new Plan) at one site that was mechanically thinned in 2020 using the Forest Soil Disturbance Monitoring Protocol (FSDMP) (Napper et al. 2009). One additional site with prescribed burning was monitored. Results showed that of the eight sites monitored, two mechanical thinning sites had minor erosion at a few points, but there was no widespread erosion. The erosion was minor and over a small area, and no corrective action was necessary, assuming the erosion will reduce over time with vegetative regrowth.

Soil monitoring showed that all seven units that had thinning the previous year showed some level of compaction, with none in the prescribed burn unit. The compaction was minor compaction (outside of skid trails), and not enough to cause detrimental effects to soil water holding capacity, runoff, or vegetation growth.

Minor forest floor impacts, topsoil displacement and rutting are common in the treated units. The duff layer is partially removed, displaced and or compacted in areas where equipment traversed. Some rut edges have increased duff layers (this suggests some displacement of forest floor due to equipment passes). Forest floor is intact except on main travel paths (skid trails and landings). Fuels management activities show these surface impacts, but they are minor and will likely recover with a few years, are not expected to cause detrimental effects to soil productivity, erosion, or vegetation growth, and require no further treatment.

### *Recommendations*

- To determine post-activity disturbance and potential impacts to soil productivity in a variety of environmental settings, we recommend sampling at least four (4) post-activity units per year and at least three (3) pre-activity units per year. This sampling will provide a greater representation of types of disturbances found in different environmental settings (and soils) on the Forest. It also provides valuable information to determine soil effects when completing environmental analysis for vegetation management projects.
- Integrate monitoring of public fuel wood gathering units to determine disturbance impacts to soil indicators.

## FS02. How are aquatic benthic macroinvertebrate communities indicating stream ecosystem integrity is being maintained in high quality waters or improved in degraded waters?

The indicators associated with this question include benthic macroinvertebrate diversity, species composition, and related metrics.

### *Relevant Plan Components*

WTR-FW-DC-02. Water quality supports State-designated beneficial uses of water and is sustained at a level that retains the biological, physical, and chemical integrity of aquatic systems and benefits the survival, growth, reproduction and migration of native aquatic and riparian species.

### *Key Results*

Figure 4 shows the California Stream Condition Index (CSCI) score for each of the creeks sampled between 2002 and 2013. The CSCI score is a measure of how well a site's observed condition matches its predicted condition. CSCI scores range from 0 (highly degraded) to greater than 1 (equivalent to reference). All creeks except Walker Creek in 2005 matched or exceeded expected conditions. It should be noted that data collection is very inconsistent with some years completely missing data and with wide variation in sample locations. This inconsistency is illustrated in Figure 4. No creek has been sampled repeatedly making it difficult to identify trends in the health of an individual stream over time.

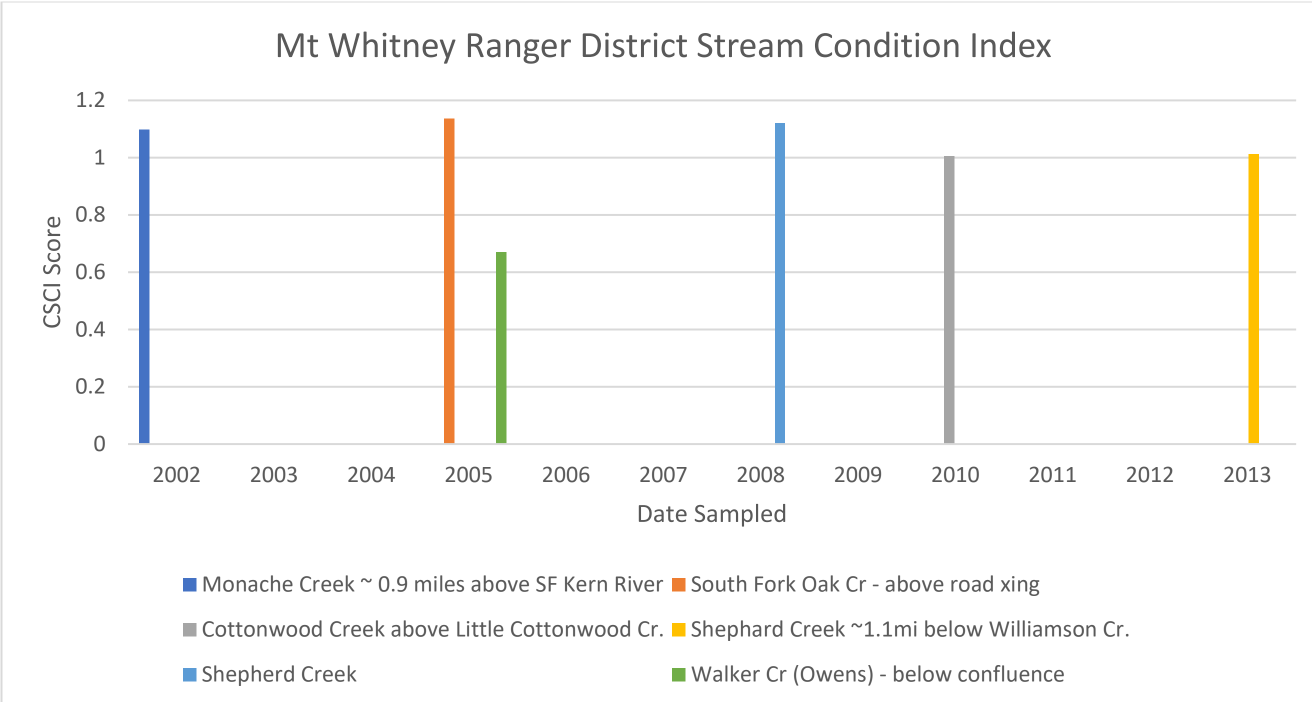



*Figure 4. Benthic Macroinvertebrate data collected on the Inyo National Forest from 2013 through 2021.*

### *Recommendations*

Due to the lack of consistency with data collection and since no data have been collected since 2014, it is our recommendation that we remove this monitoring question. Forest wide macroinvertebrate data is unable to demonstrate health of aquatic ecosystems, and there are three other monitoring questions that better demonstrate aquatic ecosystem integrity. Furthermore, the trend in macroinvertebrates is evaluated as part of the Regional broader-scale monitoring strategy and those results will be provided to the Inyo National Forest.

# Theme 2: Status of Select Ecological Conditions

## TE01. What is the status and trend of large trees in the Sierra Nevada montane forest?

The indicators associated with this question include proportion of area with large trees and number of large trees, snags, large downed logs per acre by forest type.

### *Relevant Plan Components*

TERR-OLD-DC-03: Between 40 and 80 percent of the forested landscape contains old forest areas. Old forest areas are clumps and patches of old forest components such as old trees, snags and large downed logs. These areas are irregularly distributed across the landscape and interspersed with stands of younger trees, shrubs, meadows, other herbaceous vegetation and unvegetated patches.

### *Key Results*

Overall, current forest structural conditions are meeting desired conditions for large tree and snag densities based on the Inyo Forest Plan, with some exceptions. The proportion of area with large trees (indicator 1) is currently meeting desired conditions (TERR-FW-DC 01, Table 1), and the number of large trees and snags (indicator 2) is mostly meeting desired conditions (TERR-OLD-DC Table 4). However, there is a deficit of very large trees (>40 inches in diameter) in Jeffrey pine and red and white fir forest types observed in this initial monitoring evaluation. Future monitoring will determine whether a declining trend in very large trees is evident in these and other forest types on the Inyo National Forest.

#### Indicator 1. Proportion of area with large trees

The proportional area in the Sierra Nevada montane zone of the Inyo National Forest with large trees is shown in Table 5. This includes a breakdown of the area with large trees captured in CWHR, LANDFIRE, and $F^3$ data sources. The proportional area with large trees is estimated for all ecological zones (arid shrublands and woodlands, Sierra Nevada montane, subalpine and alpine) and the Sierra Nevada montane zone exclusively (final row).

*Table 5. Acres of large trees on the Inyo National Forest, by dataset. Each row category excludes pinyon-juniper woodlands and other tree-dominated vegetation types not included in the Sierra Nevada montane zone. The desired condition for the percentage of forest land with large trees in the Sierra Nevada montane zone is provided in parentheses in the final row.*

| Dataset | Total Area (acres) or % of Montane Forest Landscape |
|---|---|
| CWHR Class5 (medium-large tree ≥ 24"DBH) | 35,270 |
| CWHR Class6 (multilayered tree) | 0 |
| LANDFIRE D (late-seral open canopy) | 33,201 |
| LANDFIRE E (late seral, closed canopy) | 17,483 |
| $F^3$ | 148,826 |
| Total acres of large trees | 234,780 |
| Total acres of large trees (accounting for spatial overlap) | 158,370 |
| Total forest land on Inyo NF (based on EVeg Covertype CON, HDW, MIX) | 432,041 |

| | |
|---|---|
| % of forest land on Inyo NF with large trees (all ecological zones) | 37% |
| Total forest land on Inyo NF (based on Sierra Nevada montane ecological zone) | 339,472 |
| % of forest land on Inyo NF with large trees (Sierra Nevada montane zone only) | 47% (40-94%) |

### Indicator 2. Number of large trees and snags per acre by forest type

Densities of large trees and snags by forest type in the Sierra Nevada montane zone are displayed in Table 6. Mean densities that are outside of the range of desired conditions include a surplus of medium to large trees ≥20 inches diameter in the dry mixed conifer and lodgepole pine forest types, a deficit of very large trees ≥40 inches diameter in the Jeffrey pine and red and white fir types, and surplus of snags ≥20 inches diameter in the red and white fir type. Most of the trees in the >20 inch diameter class were attributed to 20 to 30 inch diameter trees for all forest types. All estimates are for the entire Sierra Nevada montane zone on the Inyo National Forest (approximately 339,500 acres).

*Table 6. Mean densities of large trees and snags by forest type in the Sierra Nevada montane zone on the Inyo National Forest. The range of desired conditions for large trees at the landscape scale (from the Inyo land management plan) are provided in parentheses for comparison, with values outside desired conditions indicated in bold.*

| Forest Type | >20-inch Trees per acre | >20-inch Trees under 30-inches (%) | >30-inch Trees per acre | >40-inch Trees per acre | >20-inch Snags per acre |
|---|---|---|---|---|---|
| Dry Mixed Conifer | **32.7** (4-32) | 75 | 8.1 (2-16) | 2.4 (2-7) | 1.0 (0.2-4) |
| Jeffrey Pine | 12.5 (2-16) | 73 | 3.3 (1-8) | **0.5** (1-4) | 0.3 (0.2-4) |
| Red and White Fir | 15.3 (4-40) | 59 | 6.3 (4-20) | **2.1** (4-12) | **6.5** (0.5-4) |
| Lodgepole Pine | **17.7** (2-12) | 81 | 3.3 (2-12) | 0.9 (N/A) | 3 (0.2-4)* |
| Aspen† | 3.7 | 71 | 1.1 | 0.3 | 0.3 |

*Desired conditions for lodgepole pine are based on the entire range for dry and wet lodgepole pine types.

†Desired conditions for aspen are not provided in the Inyo Forest Plan.

## Results Discussion

### Indicator 1. Proportion of area with large trees

Based on three complementary data sources, the proportional area with large trees is slightly less than half (47%) of the Sierra Nevada montane zone on the Inyo National Forest. This estimate is within the desired conditions based on the Inyo Forest Plan (40-94%), but notably this estimate is at the lower end of this range. This suggests that current forest structural conditions on the Inyo National Forest are within desired conditions, but that future trends of large tree mortality in the southern Sierra Nevada (e.g., Restaino et al. 2019, Young et al. 2020) could result in declines in the proportional area with large trees on the Inyo National Forest. Future monitoring will be needed to evaluate trends in the proportional area with large trees in the Sierra Nevada montane zone of the Inyo National Forest.

### Indicator 2. Number of large trees and snags per acre by forest type

Densities of large trees and snags were within desired conditions for most forest types of the Sierra Nevada montane zone, with a few exceptions. Notably, there was a surplus of medium diameter (20-30 inch) trees in the dry mixed conifer and lodgepole pine forest types, a surplus of snags >20 inches in the red and white fir type, and a deficit of very large trees >40 inches in the Jeffrey pine and red and white fir types. These forest-wide patterns are consistent with documented patterns of greater densities of medium diameter trees in contemporary than historical mixed conifer stands in the southern Sierra Nevada (e.g., Stephens et al. 2015) associated with long-term fire exclusion and historical logging impacts. Similarly, lower densities of very large trees (>40 inches) and greater densities of larger (>20 inch) snags in some forest types on the Inyo National Forest are consistent with patterns observed in other parts of the Sierra Nevada (Safford and Stevens 2017, Meyer and North 2019), likely associated with climate change, forest densification, and recent drought events (Meyer et al. 2019, Restaino et al. 2019, Young et al. 2020). Regional warming trends will likely contribute to a declining trend in large trees and increasing trend in large snags in the Sierra Nevada montane zone of the Inyo National Forest, especially in the absence of forest stand reduction treatments that reduce moisture stress.

### *Recommendations*

1. The monitoring question should have "old forests" added (i.e., What is the status and trend of large trees and old forests?), because the current wording of the question doesn't cover other important aspects of indicators 1 and 2, such as the landscape extent of old forests and snag densities.
2. Remove logs from Indicator 2 because desired conditions for log densities are not provided in the Inyo's Plan.

## TE02. What is the status of pinyon-juniper woodlands?

The indicators associated with this question include Pinyon-juniper spatial extent and number, type, and extent of disturbance events in pinyon-juniper woodlands (such as wildfire, disease, drought).

### *Relevant Plan Components*

TERR-OLD-DC-5: Pinyon-juniper types have a mosaic of trees and open areas that provide wildlife habitat, contribute to functional soils, and are resilient to disturbances such as fire, invasive species and climate change.

### *Key Results*

Results for the two indicators suggest that pinyon-juniper woodlands on the Inyo National Forest are currently meeting the Forest Plan desired conditions. However, current patterns in canopy cover loss, tree mortality, wildfire acreage, and treatment acreage in pinyon-juniper woodlands suggest that pinyon-juniper woodlands may experience a declining trend in the future in response to several interacting stressors. Changes to the evaluation of indicators 1 and 2 (see Q1 above) and implementation of a focused monitoring plan for pinyon pine on the Inyo National Forest would help determine if such a declining trend in the condition of pinyon-juniper woodlands is occurring.

## Data

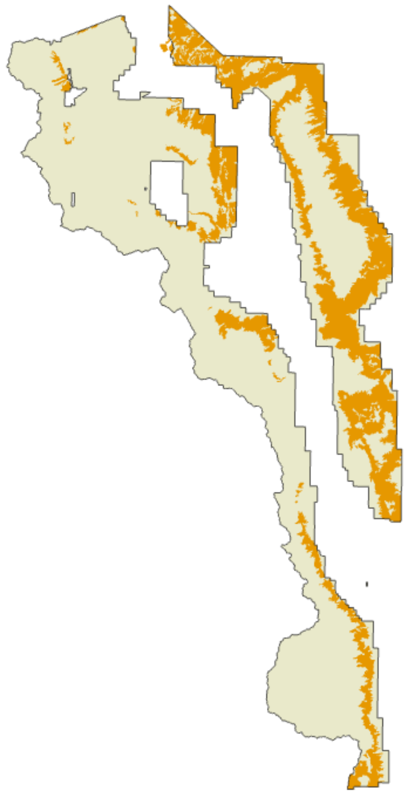


*Figure 5. Location of Pinyon-juniper woodlands on the Inyo NF.*

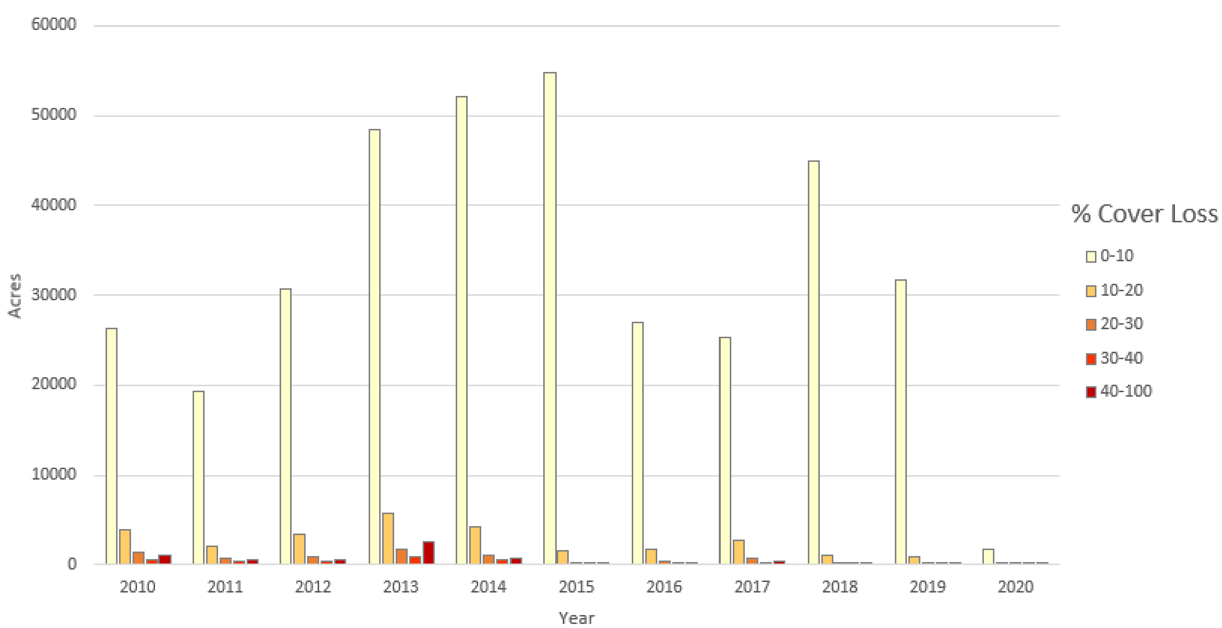



*Figure 6. Ecosystem Disturbance and Recovery Tracker (eDaRT) canopy cover loss per 30 m pixel within pinyon-juniper forests in years 2010-2020.*

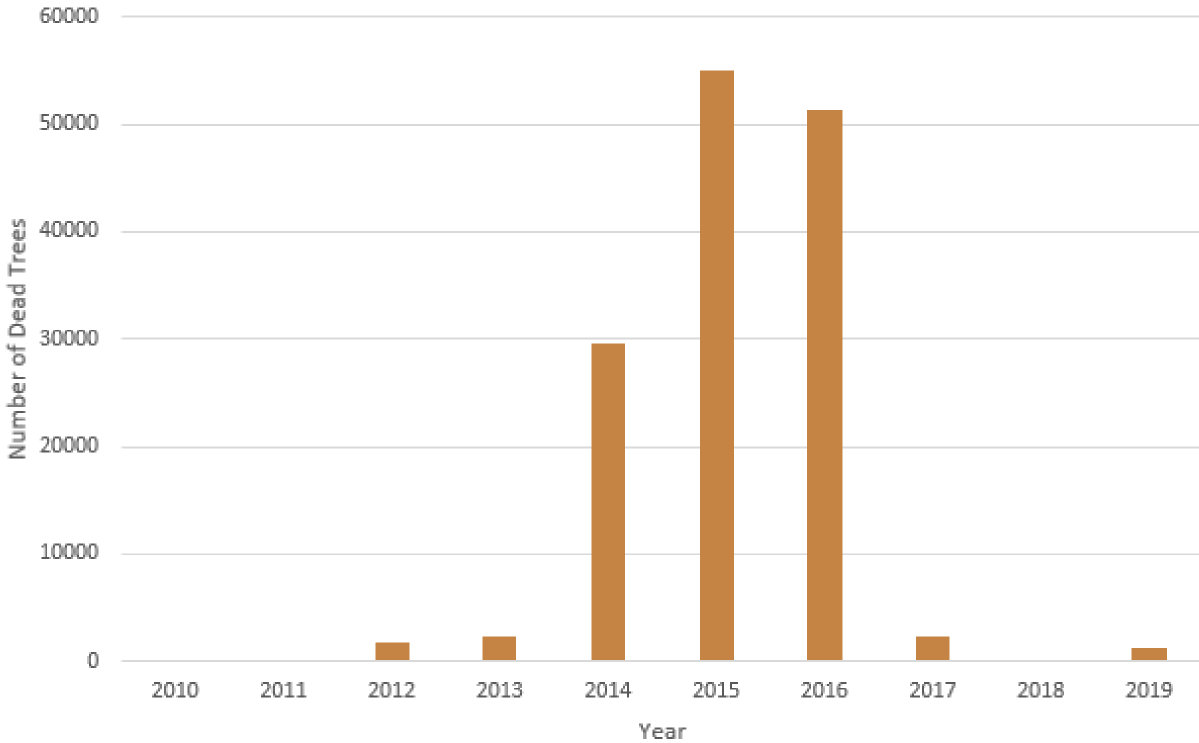



*Figure 7. Aerial Detection Survey (ADS) results for number of pinyon pine trees dead on the INF for years 2010-2019.*

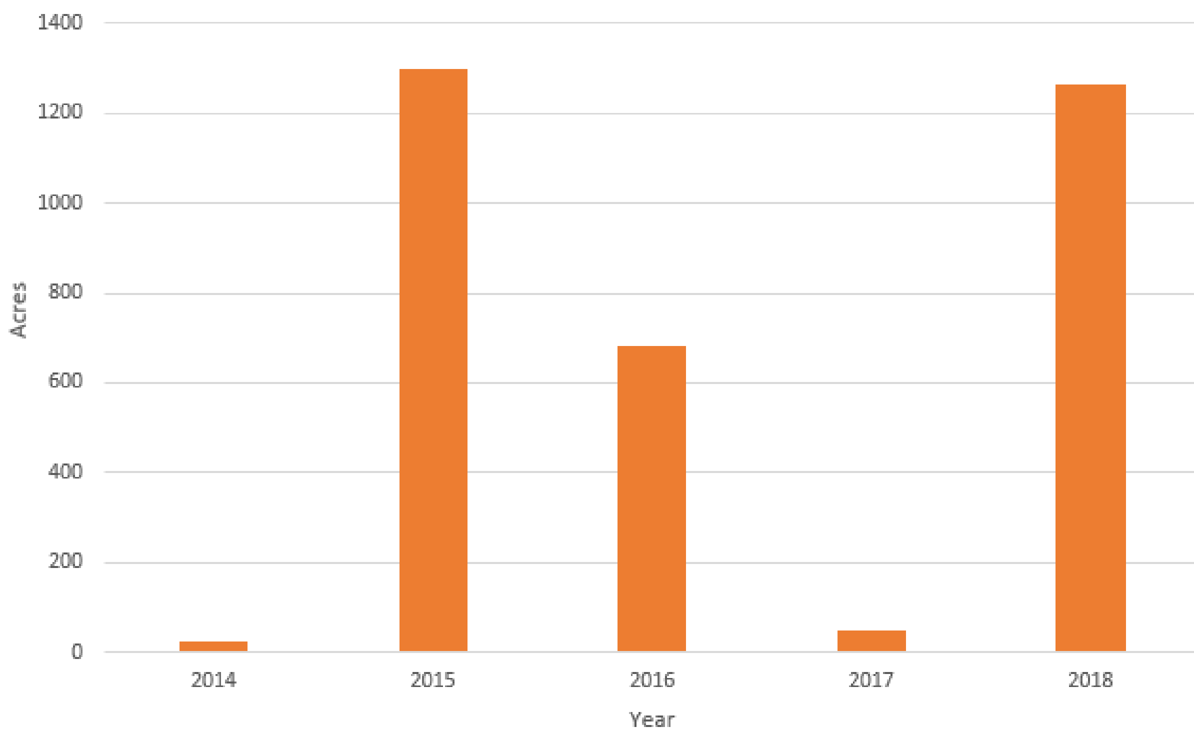



*Figure 8. Acres of wildland fire, by year, within pinyon-juniper extent, Inyo NF.*

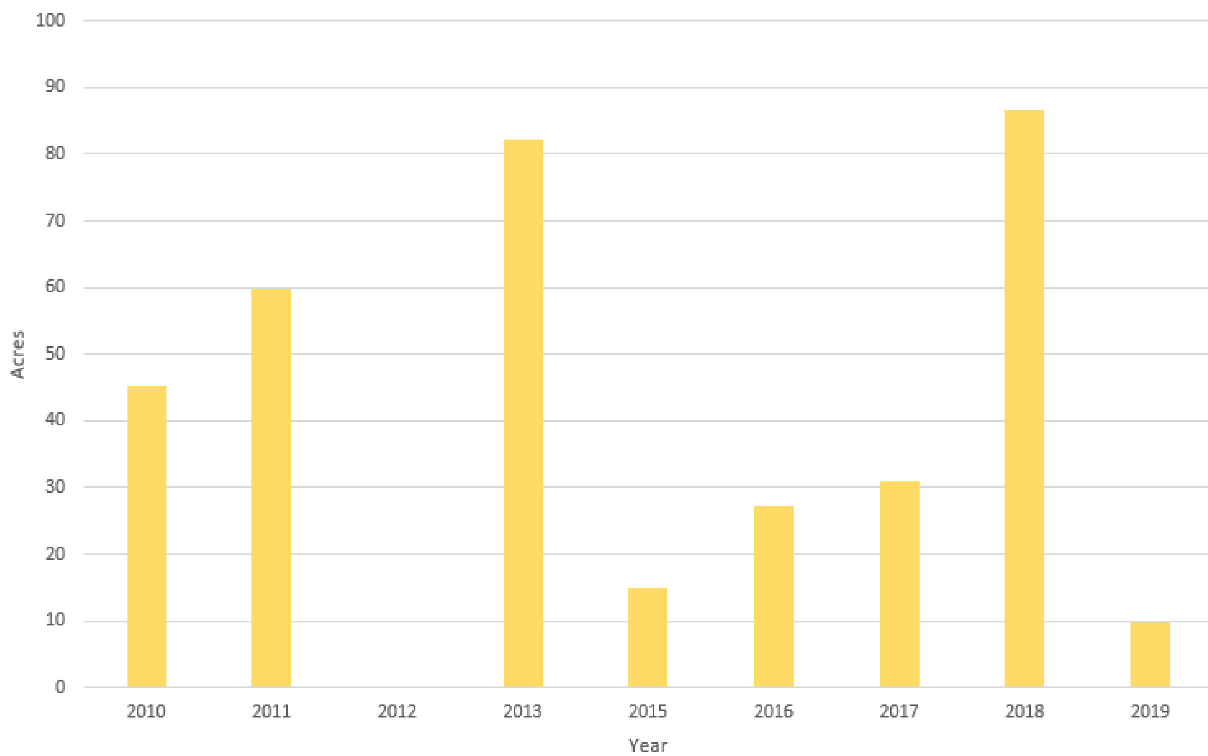



*Figure 9. Acres of treatments, by year, within pinyon-juniper extent, Inyo NF, as documented in the FACTS database.*

## Results Discussion

The spatial extent of pinyon-juniper woodlands on the Inyo National Forest is about 513,500 acres, and it primarily occurs in the arid shrublands and woodlands ecological zone on all districts. Information about potential changes in extent over time is not available, but recent trends can be somewhat inferred from data sources for tree mortality and expansion into new habitats. The eDaRT and Aerial Detection Survey (ADS) data sources for tree mortality both indicate an up-tick in tree mortality during and after the 2012-2016 drought in California, with a peak level of percent canopy cover loss detected in 2013-2015 (based on eDaRT) and peak number of dead pinyon trees observed in 2014-2016 (based on ADS) (Figure 6 and Figure 7). Even during years with widespread losses in canopy cover (thousands of acres affected), eDaRT data indicated canopy declines were mostly slight (i.e., less than 10% canopy cover change, or 10% per 30 m pixel). Larger mortality events were localized in the Kennedy Meadows area of the southeastern Sierra Nevada, with additional detections in the White & Inyo Mountains and patches of mortality throughout the Crowley Reservoir/Benton Range/Glass Mountains area. It is uncertain if the mortality events from 2010-2020 have resulted in the loss of pinyon-juniper woodlands on the Inyo National Forest. Additional focal monitoring of these arid woodlands in the future would help assess whether recent mortality is persistent and resulting in changes in pinyon-juniper extent over time, or whether there is evidence of recruitment to replace mortality of older, larger trees.

No data were available for the extent of pinyon-juniper expansion into shrublands. Therefore, it cannot be determined if the spatial extent of these arid woodlands is experiencing an upward or downward trend.

Acres of wildland fire in pinyon-juniper woodlands on the Inyo National Forest based on Fire and Resource Assessment Program (FRAP) data totaled more than 3,310 acres over the past five years (Figure 8). There were no obvious trends in acres burned in wildland fires from 2014 to 2018, although there was high variation among years with fewer than 50 acres burned in 2014 and 2017 to more than 1200 acres burned in 2015 and 2018.

Fuel reduction treatments in pinyon-juniper woodlands on the Inyo National Forest based on FACTS data totaled 358 acres over the past decade (Figure 9). Overall, treatment rates remained relatively low (less than 90 acres per year; much lower than other coniferous forest types) but variable (range: 10-87 acres) over the past five years. Effects of fuel reduction treatments may be monitored in the future based on the implementation of a pinyon pine monitoring plan for the Inyo National Forest (currently in development and dependent on staff capacity).

Overall, recent patterns in canopy cover loss, tree mortality, and burned acres in pinyon-juniper woodlands suggest that this ecosystem type may be experiencing declines in extent due to drought, insects, climate change, and wildfires. However, future forest-level monitoring will be required to further assess trends in pinyon-juniper woodlands on the Inyo National Forest.

### ***Recommendations***

1. The indicators for TE02 in Inyo Monitoring Guide should be corrected for consistency with the Inyo Forest Plan Monitoring Program. Currently, indicator 2 is incorrect in the Monitoring Guide and has been corrected in the section above.
2. Evaluation of indicator 1 (pinyon juniper spatial extent) would benefit from the inclusion of pinyon pine expansion data obtained through remote-sensing imagery. For indicator 2, the inclusion of earlier ADS data (pre-2010) and earlier fire (pre-2014) data would provide greater insights into longer-term trends in pinyon mortality.
3. Develop a separate, focused monitoring plan for pinyon-pine on the Inyo National Forest, in conjunction with remote sensing.

## TE03. What is the condition of sagebrush communities?

The indicators associated with this question include:

(1) proportions of seral classes, sagebrush cover

(2) acres of treatment to improve age class distribution

(3) acres of wildland fire, and

(4) percent native understory vegetation.

### *Relevant Plan Components*

TERR-SAGE-DC-01: The sagebrush type has a diversity of age classes, stand structure, cover classes and understory composition.

### *Key Results*

Sagebrush ecosystems outside of fire and treatment perimeters have generally shown a trend toward increasing decadence, including crown thinning and mortality, which are expected effects of the drought during the last decade. In other areas, livestock grazing appears to have contributed to declining crown health, by hedging of larger crowns, and trampling of smaller plants in interstices. The extent to which sagebrush may exhibit resilience in these stressed and decadent stands when they do experience fire or treatment is unknown. Dry crowns may burn at higher intensity. However, the now discontinuous stands (i.e. where herbs are suppressed due to drought or sagebrush cover declined), may counter-act this effect, limiting fire spread and/or severity.

Across the forest, fire and treatments have contributed to maintaining some local diversity in sagebrush age classes, stand structure, and cover classes. However, a negative consequence of wildland fire on understory composition has been an increasing proportion of non-native species, especially in the Sierra Nevada & Eastern Slopes ecoregion.

### Indicator 1. Proportions of seral classes, sagebrush cover

#### *Forest-wide Analysis*

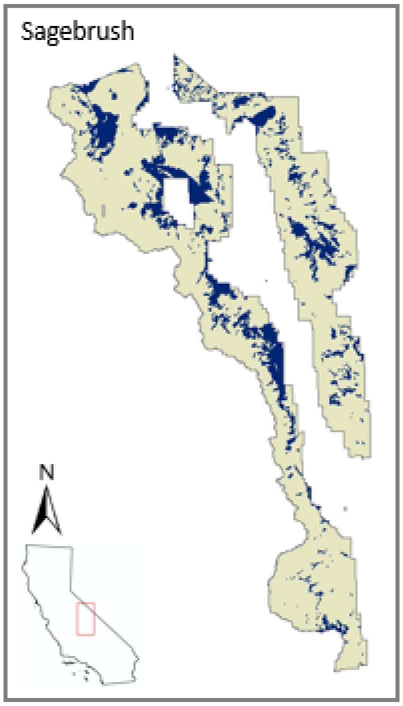



*Figure 10. Sagebrush ecosystems on the Inyo NF as mapped in the Inyo NF Terrestrial Ecological Unit Inventory.*

Ecology plot measurements of sagebrush cover (Figure 10) were available for years 2004-2020, and values were summarized. Most plots were measured only 1-3 times within this time period, limiting interpretation of trend over time. Nonetheless, the sample size for each 3-6 year period summarized was over 100 plots, and the selection of plots sampled, which was based on accessibility, is not expected to bias overall interpretations. For the Sierra Nevada & Eastern Slopes ecoregion, a slight decrease in sagebrush cover occurred between 2004-2020. This trend is consistent with the effects of fire during this time period, where fire-following herbs and resprouting shrubs have replaced sagebrush; continued monitoring will be required to assess potential sagebrush recovery in future years. Slight increases in sagebrush cover occurred within the Long Valley, Mono Basin, Glass Mts. ecoregion and Whites & Inyos. This change is very slight and highly variable by location. The additional analyses in the Crowley Basin, discussed below, shed light on possible causes and additional detail of these trends.

Table 7 illustrates the number of ecology plots assigned to different seral stage classes over time. Seral stages were assessed qualitatively in the field, based on visible evidence of disturbance, presence of disturbance-tolerant species, and age and health of shrub species. The increase in plots characterized as decadent is consistent with apparent drought-related decline in sagebrush health. In some localities, trailing and hedging from livestock use was identified as the cause of increased decadence of stands.

*Table 7. Ecology plot measurements of sagebrush seral stage class ranks, summarized by decade and by ecoregion. Seral stage categories were assessed qualitatively in the field, based on visible evidence of disturbance of any kind, and presence of early seral indicator species. Note that not all plots were measured in all time frames.*

| Ecoregion and Seral stage | Number of plots 2004-2010 | 2011-2017 | 2018-2020 | Grand Total |
|---|---|---|---|---|
| **Long Valley, Mono Basin, Glass Mts.** | **77** | **88** | **82** | **247** |
| 1-Early | 5 | 3 | 1 | 9 |
| 2-Mid | 15 | 23 | 21 | 59 |
| 3-Late | 45 | 34 | 22 | 101 |
| 4-Decadent | 12 | 28 | 38 | 78 |
| **Sierra Nevada & E Slopes** | **17** | **31** | **21** | **69** |
| 1-Early | 0 | 1 | 1 | 2 |
| 2-Mid | 9 | 14 | 10 | 33 |
| 3-Late | 8 | 13 | 6 | 27 |
| 4-Decadent | 0 | 3 | 4 | 7 |
| **Whites & Inyos** | **2** | **29** | **5** | **36** |
| 2-Mid | 0 | 9 | 1 | 10 |
| 3-Late | 2 | 20 | 2 | 24 |
| 4-Decadent | 0 | 0 | 2 | 2 |
| **Grand Total** | **96** | **148** | **108** | **352** |

Seral stage information was inferred using fire perimeters and FACTS information as a proxy for recent disturbance history. Those results are presented under Indicators 2 and 3.

eDaRT outputs were summarized for years 2010-2020 to represent loss of canopy cover in sagebrush ecosystems across the entire forest (Figure 11).

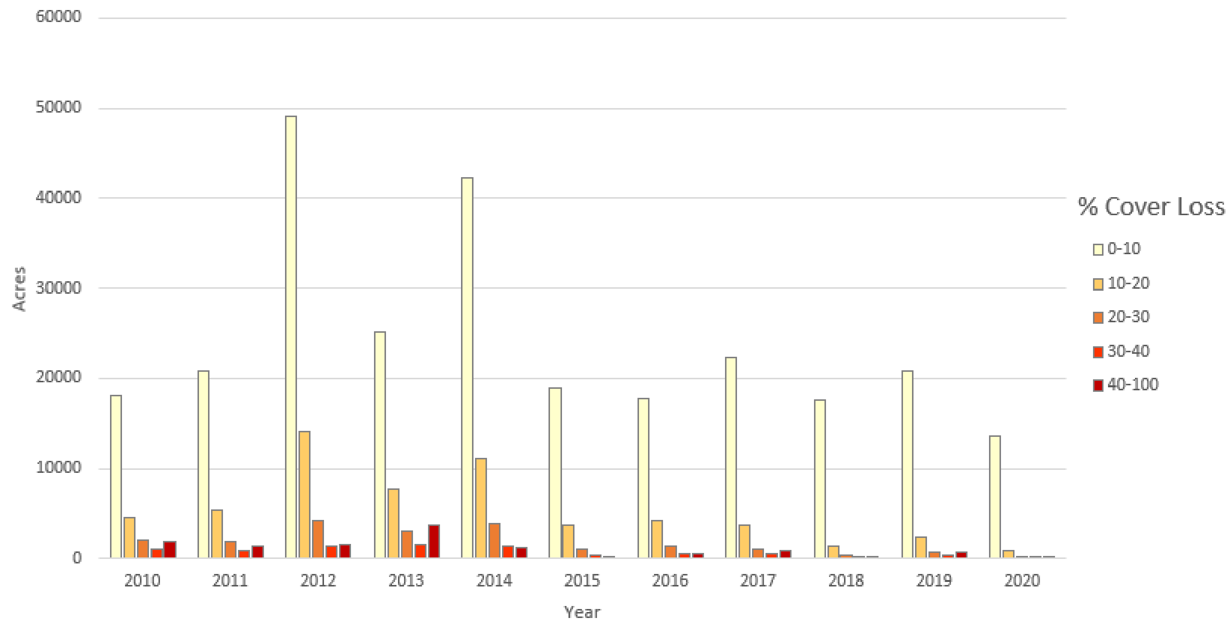



*Figure 11. Ecosystem Disturbance and Recovery Tracker (eDaRT) canopy cover loss per 30 m pixel within sagebrush ecosystems in years 2010-2020. The eDaRT mortality magnitude index that represents % cover loss was calibrated for forested ecosystems, so these values should be viewed as a relative proxy for canopy cover trends over time.*

Spatial models of sagebrush cover change from 2005-2020 were available for the Crowley Basin. Outputs were generated using the R5 Remote Sensing Lab's $F^3$ model. Model inputs included field-based plot measurements as training data, optical (NAIP and RapidEye) and radar (ALOS Palsar) remote sensing data, and topographic variables. Repeat photos were also available for all field plots (Figure 12 through Figure 15).

In the Crowley Basin, it is evident that the overall mean increase in sagebrush cover is due to complex patterning, with declines in some areas. Areas of sagebrush cover increase have occurred in meadow habitats, and also as the result of increasing individual crown size in increasingly decadent stands. In the latter case, the larger crowns are often thinner in structure, with more leafless twigs. Loss of sagebrush cover in many areas is likely the result of the drought that peaked in 2014 but continues to the present day. These losses are most evident north of Antelope Springs road on the slopes of the Watterson Canyon area, and south of the Mammoth airport. In these areas, other drought-tolerant species, such as bitterbrush, have increased in cover. Loss of sagebrush due to fire has occurred within burn perimeters, and recovery there has been patchy. For example, 20+ years after the Mclaughlin Fire, sagebrush have not recovered and other species are dominant over sagebrush cover.

*See following pages for repeat photos at plots*

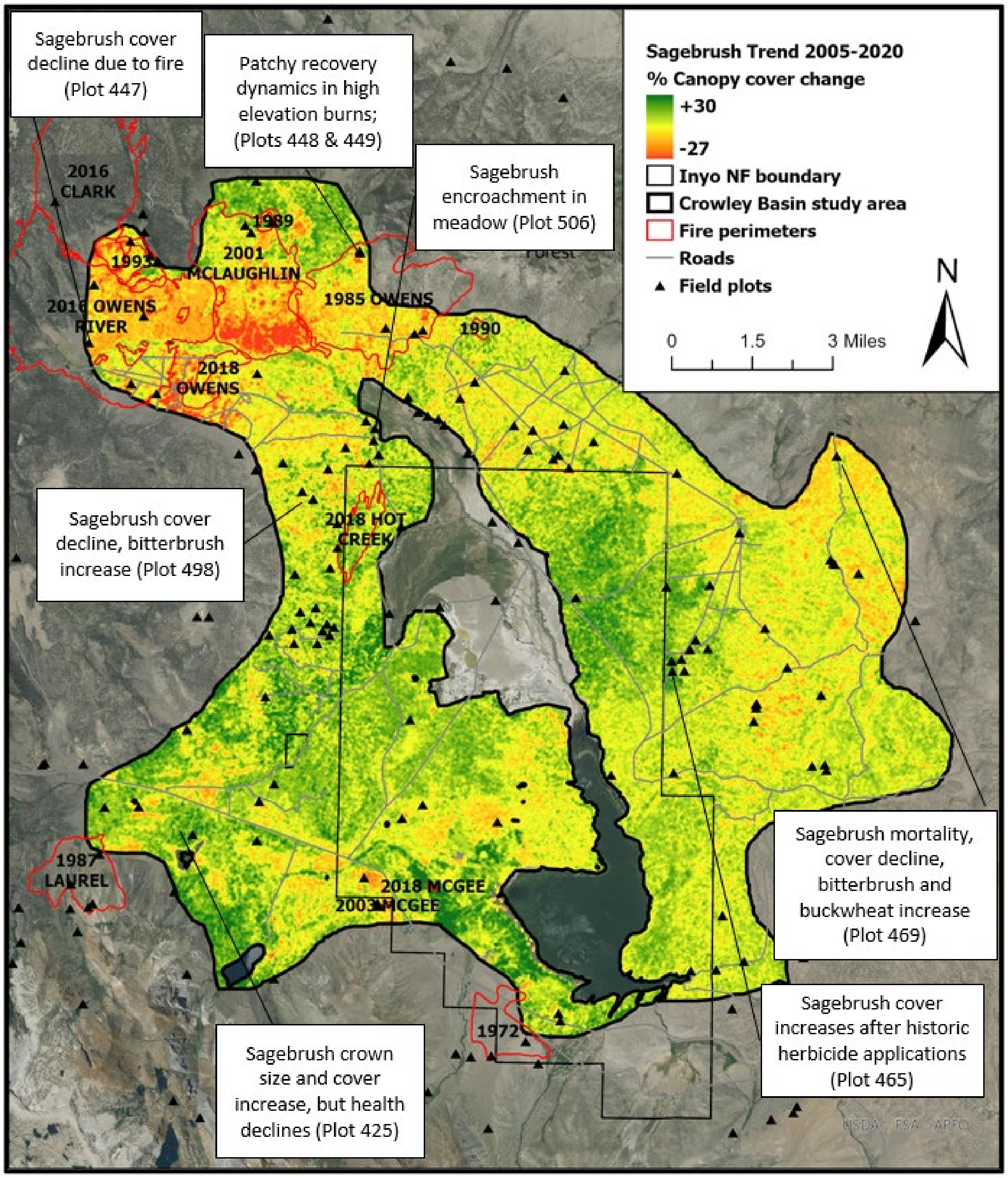



*Figure 12. Spatial models of sagebrush cover change 2005-2020 for the Crowley Basin. Outputs were generated using the R5 Remote Sensing Lab's F3 model.*

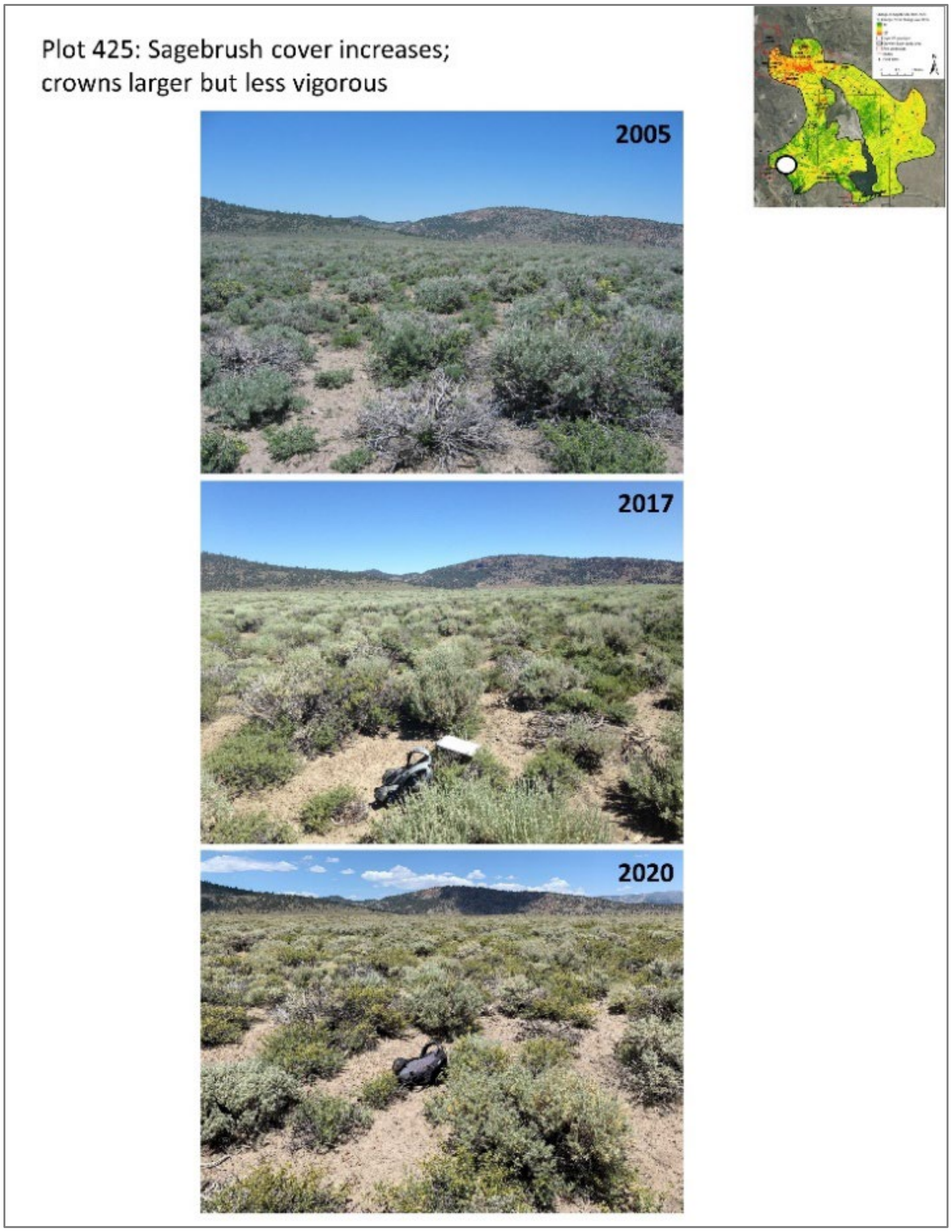



*Figure 13. Repeat photo from 2005 through 2020 for Plot 425 in the Crowley Basin*

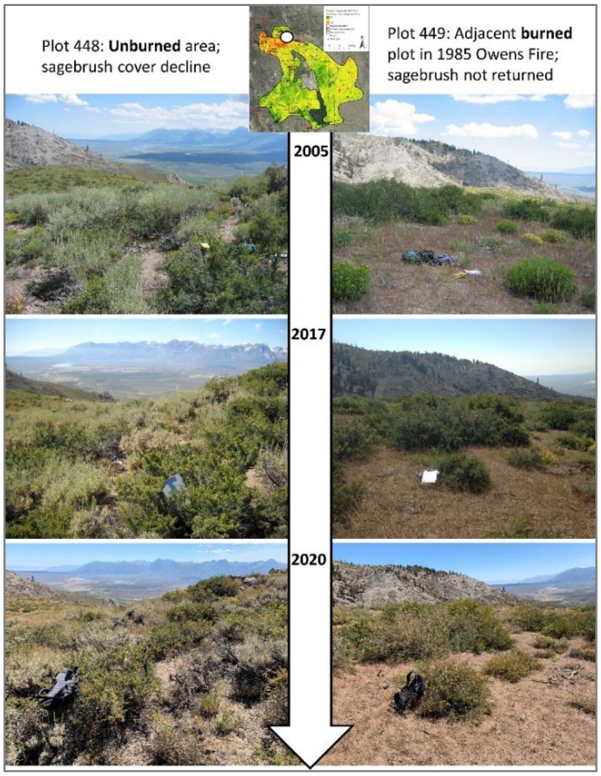



*Figure 14. Repeat photo from 2005 through 2020 for Plot 448 in the Crowley Basin.*

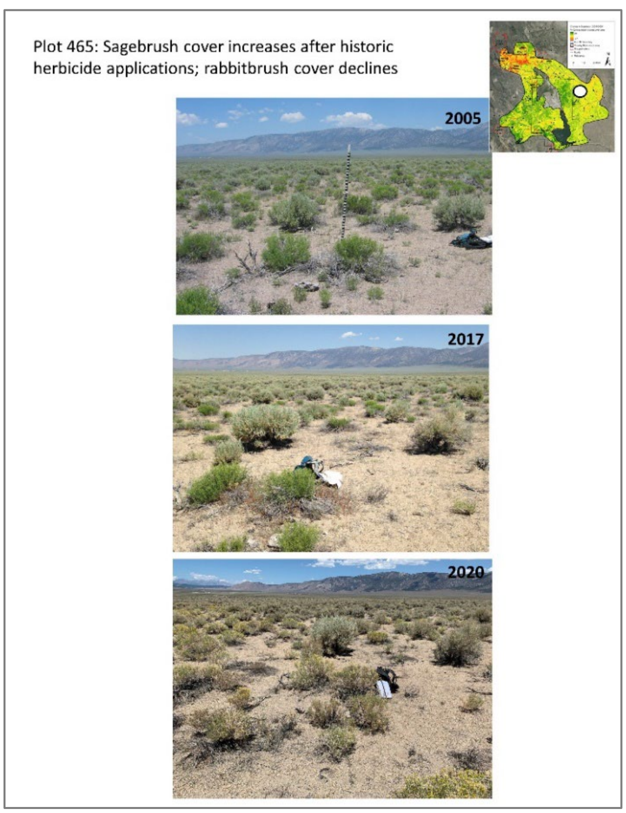



*Figure 15. Repeat photo from 2005 through 2020 for Plot 465 in the Crowley Basin.*

### Indicator 2. Acres of treatments to improve age class distribution

Acres of treatments within sagebrush ecosystems have varied from 0-80 acres per year between 2010-2020. Effectiveness has not yet been well monitored.

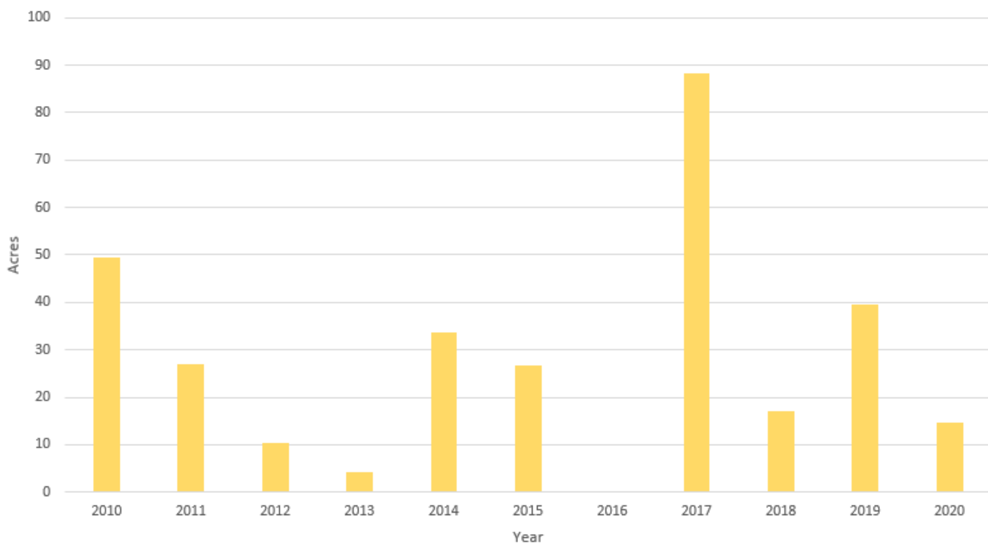



*Figure 16. Acres of treatments to improve age class distribution, from the FACTS database in sagebrush ecosystems for the Inyo NF.*

### Indicator 3. Acres of wildland fire

Acres of wildland fire in sagebrush ecosystems have varied from 0 to over 6000 acres per year between 2010-2020. Significant fires in that time period include Clark and Owens River (2016) fires in the Long Valley area, Georges (2018), Taboose (2019), and Round (2015) on the Eastern Slopes, and Beach (2020) in the Mono Basin. Plot data pre- and post-fire in the Owens River fire footprint show non-native species are present in some areas of these burns, including Russian thistle and cheatgrass. However, native herbs and shrubs are currently dominant.

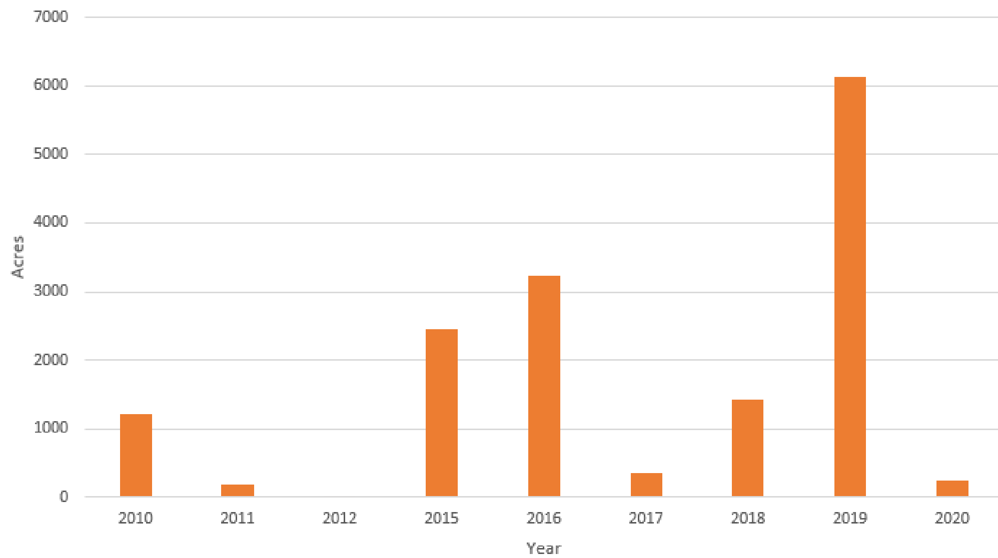



*Figure 17. Acres of wildland fire in sagebrush ecosystems for the Inyo NF.*

### Indicator 4. Percent native understory vegetation

Data collected between 2004-2020 illustrates that understory cover in sagebrush ecosystems is dominated by native species in most locations (Figure 18). However, there has been a trend of decreasing proportional native cover in the Sierra Nevada & Eastern Slopes ecoregion. This trend appears to be due to a combination of fire, drought, and the progressive increase in the seedbank of non-native species over time.

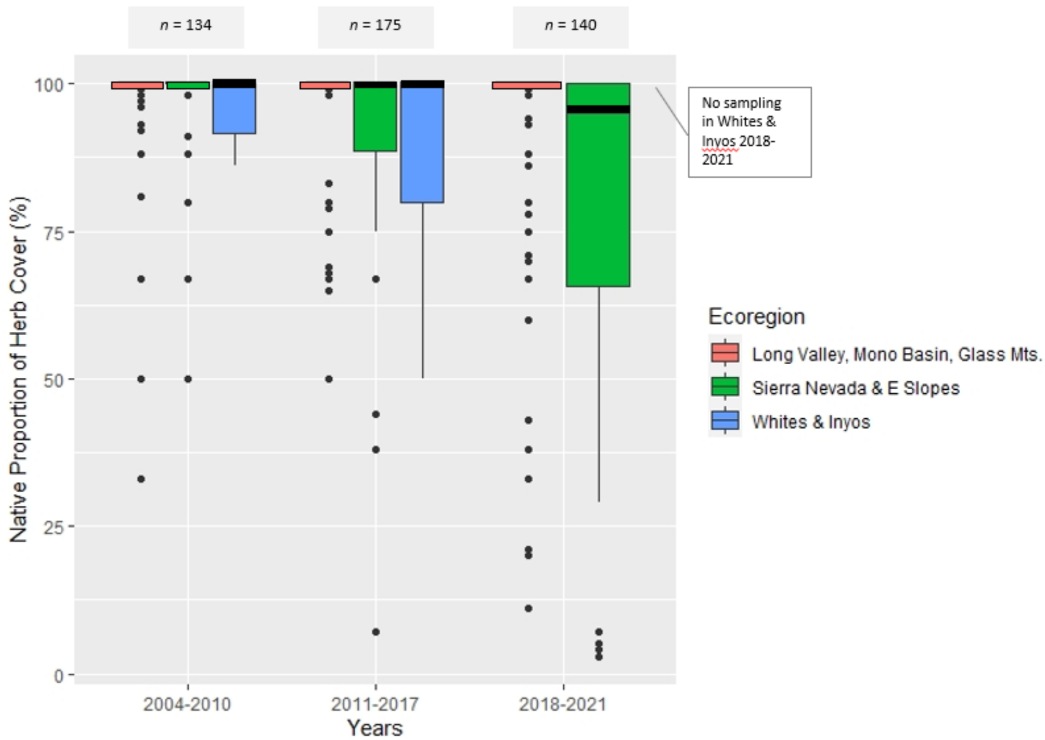



*Figure 18. Box and whisker plots of the proportion of herbaceous herb cover that is native for Inyo NF ecology plots (0.1 acre) in sagebrush ecosystems. Boxes include median, two hinges for 1st and 3rd quartiles, whisker to largest value no further than 1.5 the interquartile range, and outliers. Sample size (n) per time period along top.*

### ***Recommendations***

- We recommend adding an indicator for sagebrush regeneration. The high levels of decadence (sagebrush mortality), combined with absence of information on sagebrush recruitment makes it difficult to assess age class structure and likely future trends following disturbance. Currently, it is assumed that early seral conditions in stands previously dominated by sagebrush (but may or may not contain sagebrush post-disturbance) will result in sagebrush-dominated ecosystems in the future.

## FS01. How is the abundance of Cheatgrass and red brome (nonnative Bromus spp.) changing?

The indicators associated with this question include the spatial extent and percent cover of Cheatgrass and red brome.

### *Relevant Plan Components*

TERR-SAGE-DC-02: Sagebrush ecosystems are resilient to fire and other disturbances including grazing, recreation, invasive species (including cheatgrass) and climate change.

SPEC-SG-DC-06: The extent and dominance of non-native annual grass species, such as cheatgrass, is limited and does not lead toward reduction in the suitability of sage-grouse habitat.

### *Key Results*

Between 2006-2020, there was in increase in areas with over 50% invasive grass cover. However, the recent drought appears to have suppressed growth in most recent years, so the rate of increase may be less than would be expected in higher precipitation conditions.

Invasive grass cover estimates are higher on south-facing slopes and where there has been disturbance such as wildland fire. Ecology plot data summaries presented in TE03 confirm some of these patterns, of mostly localized sharp increases in invasive grass cover in disturbed areas, and either no change or modest increases elsewhere.

The invasive grass model for the Inyo NF has a root mean square error (RMSE) of 12%, which means that, on average, the predicted % herb cover values per 30 m pixel are within 12% of the observed values from the field training dataset. Some bias does occur in the model, where low values tend to be overestimated and high values are typically underestimated. Importantly, although the model is calibrated for the phenology of non-native grasses, this signal can be confused with that of native annuals and native perennials. Nevertheless, general patterns of the model described above match expectations based on field observations.

The forest-wide analysis and lack of focus on sagebrush made it difficult to interpret results meaningfully and did not address the cited desired conditions related to sagebrush and sage-grouse.

## Data

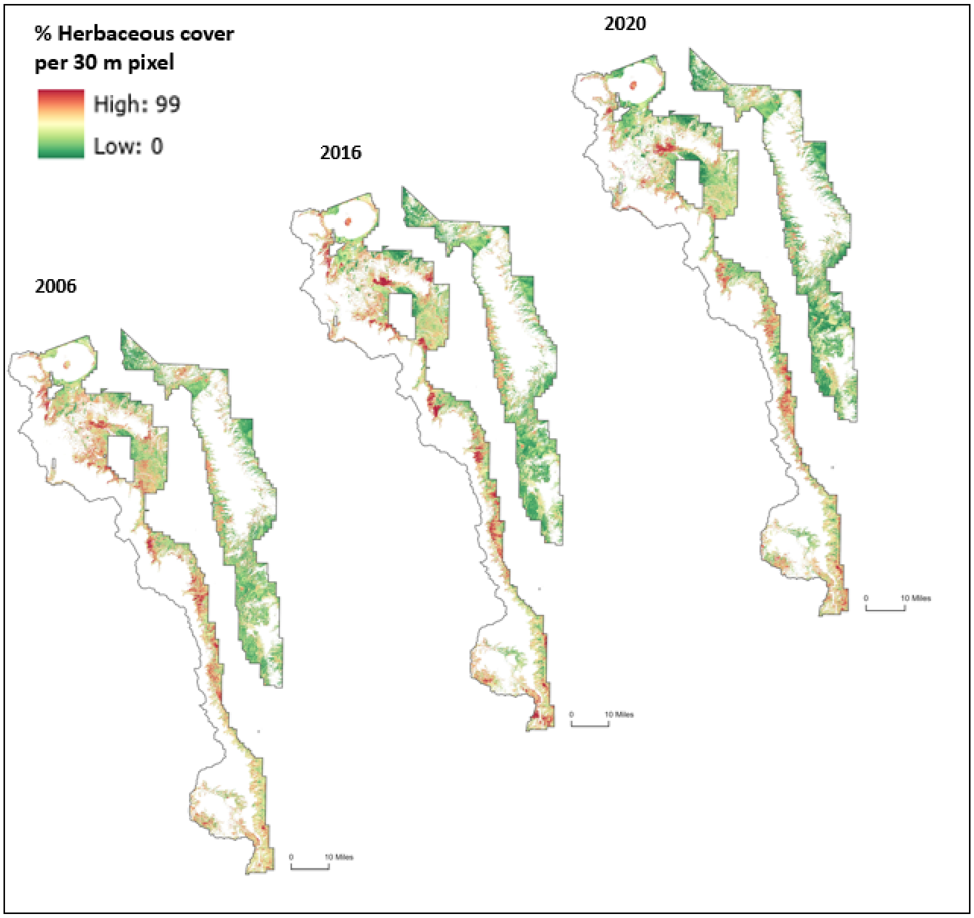



*Figure 19. Invasive grass cover model for Inyo NF shrublands for three years.*

### *Recommendation*

- Refine the questions and indicators to focus only on sagebrush ecosystems. The forestwide analysis is not useful in understanding the cited desired conditions that are only for sagebrush ecosystems.

## AE01. What is the vegetative condition of selected grazed and ungrazed meadows?

The indicators associated with this question include: (1) rangeland ecological condition; (2) species richness, species diversity, and plant functional groups; (3) range greenline monitoring; and (4) vegetation community types.

### *Relevant Plan Components*

RCA-MEAD-DC-05: Meadows have substantive ground cover and a rich and diverse species composition, especially of grasses and forbs. Meadows have high plant functional diversity with multiple successional functional types represented. Perennial streams in meadows contain a diversity of age classes of shrubs along the streambanks, where the potential exists for these plants.

### *Key Results*

The indicators for this question are monitored using rooted frequency transects, greenline, and the Inyo National Forest wide Utilization Standards protocol. Rooted frequency transects and greenline are conducted by the R5 rangeland monitoring crew on a selected group of meadows that are monitored every 5 years. The Inyo National Forest Wide Utilization Standards protocol is conducted by Forest staff. Since the implementation of the 2019 Land Management Plan (LMP) the R5 monitoring crew has monitored 23 meadows and Forest staff have monitored three meadows. This information is summarized in Figure 20 and Figure 21 below.

Insufficient data have been collected to make conclusions about overall trends that may be occurring under the implementation of the 2019 Inyo Forest Plan. Although overall trends cannot be determined on a Forest wide scale, a chart has been included that shows changes in vegetative condition class (increase in condition class “up”, no change “neutral”, or “down” downward change in condition class) since the last time each meadow was monitored.

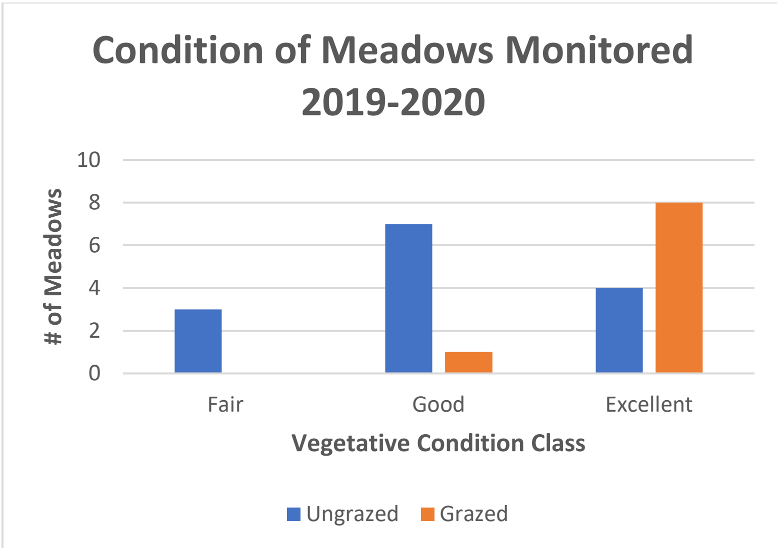



*Figure 20. Condition of meadows monitored in 2019 and 2020.*

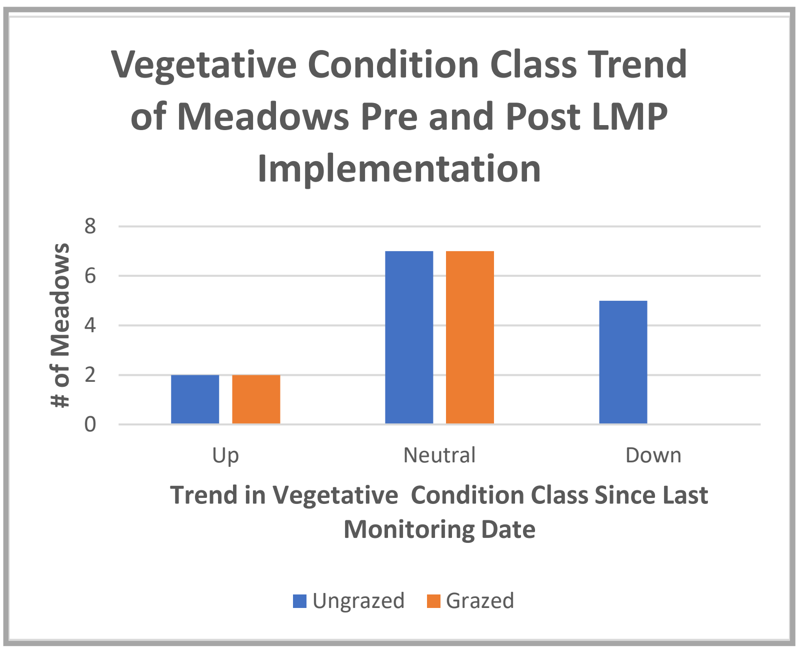



*Figure 21. Vegetation condition class trend of meadows, showing trends from before and after the 2019 land management plan.*

### *Recommendations*

No recommendations.

## AE02. To what extent are riparian areas functioning properly across different management areas and levels of disturbance?

The indicators associated with this question include vegetation cover, structure, and composition as well as floodplain and channel physical characteristics.

### *Relevant Plan Components*

MA-RCA-DC-05: Riparian areas provide a range of substrates to sustain habitat for a variety of aquatic and terrestrial fauna within the natural capacity of the system.

MA-RCA-DC-06: Soil structure and function is sustained to infiltrate and disperse water properly, withstand erosive forces, sustain favorable conditions of stream flow, and cycle nutrients. Associated water tables support riparian vegetation and restrict non-riparian vegetation.

### *Key Results*

The indicators for question AE02 are monitored using the Inyo National Forest wide Utilization Standards protocol and Proper Functioning Condition (PFC) protocol. Limited data has been collected since the implementation of the 2019 Land Management Plan for the Inyo National Forest. One riparian area located within the Dexter Creek grazing allotment was monitored in 2019. This site was rated as being in fully functional condition.

PFC ratings data were summarized in 2013 Assessments, as part of development of the land management plan. This information can be used for comparison for post-plan surveys, when there are more data available.

*Table 8. Functioning ratings from 2013 of meadows grazed by pack stock (horses and mules) in the Ansel Adams and John Muir Wildernesses and by livestock in grazing allotments.*

| Proper Functioning Condition Ratings | Meadows in the Ansel Adams and John Muir Wildernesses | Cattle and Sheep Grazing Allotments |
|---|---|---|
| Proper Functioning Condition | 59% (90) | 59% (67) |
| Functional-at-risk | 40% (60) | 37% (42) |
| Non-functional | 1% (2) | 4% (5) |

### *Recommendations*

No recommendations.

# Theme 3: Status of Ecological Conditions for At-Risk Species

## AR01. To what extent is the integrity of special habitats for at-risk plants and animals being maintained or improved?

The indicators associated with this question include special habitat extent (acres) and health (e.g. species composition), and number, type, and extent of disturbance events (e.g., adverse effects from authorized or unauthorized use).

### *Relevant Plan Components*

TERR-SH-DC-01 The integrity of special habitats is maintained or improved from current conditions. Composition, diversity, and structure are maintained in all areas, including those with multiple-use activities.

### *Key Results*

There are currently 23 special habitat types occurring across the Inyo NF, totaling over 100,000 acres (Table 9 and Figure 22). However, the distribution of individual special habitats is often restricted to one or a few areas of the forest. For example, dry forb is concentrated south of Mono Lake and on the Kern Plateau; limestone is only found in the White and Inyo mountains; and the black oak stands (*Quercus kelloggii*) are restricted to a few drainages of the southeastern Sierra escarpment on the Mt Whitney ranger district. Limestone rock type is by far the most abundant special habitat, while several specific roof pendant and other metamorphic rock types are the least abundant. Just under half of the special habitat area (42,630 acres) is located within designated wilderness areas.

*Table 9. Area of special habitats, by type, known across the Inyo National Forest. Acres are shown in total and by Ranger District.*

| | | | Area by Ranger District (acres) | | | |
|---|---|---|---|---|---|---|
| **Special Habitat** | **Special Habitat (acres)** | **# of Sites (polygons)** | **Mono** | **Mammoth** | **White Mountain** | **Mt. Whitney** |
| **Alkali Flat** | 9,376 | 17 | 9,113 | 234 | 29 | |
| **Banded calc-hornfels and pelitic hornfels** | 210 | 2 | | | 210 | |
| **Bloody Mountain formation** | 2,174 | 17 | | 2,032 | 142 | |
| **Bright Dot formation** | 1,207 | 8 | | 1,061 | 145 | |
| **Dry Forb** | 11,580 | 64 | 9,093 | 522 | 15 | 1,950 |
| **eolian - dune field** | 1,469 | 12 | 1,469 | | | |
| **eolian - sand sheet** | 2,377 | 4 | 2,377 | | | |
| **Gull Lake Roof Pendant** | 1,202 | 14 | 1,202 | | | |
| **Hornfels** | 1,172 | 2 | 1,172 | | | |
| **Limestone** | 48,550 | 22 | | | 15,775 | 32,775 |
| **Log Cabin Mine Roof Pendent** | 88 | 3 | 88 | | | |
| **Marble** | 381 | 5 | 28 | | 352 | |
| **Metasediment of the Bishop Creek Roof Pendant.** | 39 | 2 | | | 39 | |
| **Metasediment of the Gull Lake Roof Pendant** | 7,032 | 12 | 7,032 | | | |
| **Metasediments** | 400 | 2 | 400 | | | |
| **Mount Aggie formation** | 1,648 | 14 | | 725 | 923 | |
| **Mount Baldwin Marble** | 1,473 | 27 | | 1,086 | 387 | |
| **Mount Morison Sandstone** | 554 | 6 | | 516 | 37 | |
| **Quercus kelloggii** | 541 | 16 | | | | 541 |
| **Sand dune deposits** | 7 | 1 | 7 | | | |
| **Sand dunes** | 9,035 | 40 | 9,035 | | | |
| **Seep** | 297 | 13 | 61 | 96 | 100 | 40 |
| **Siliceous calc-hornfels** | 480 | 3 | | | 480 | |
| **Totals** | **101,292** | **306** | **41,077** | **6,272** | **18,634** | **35,306** |

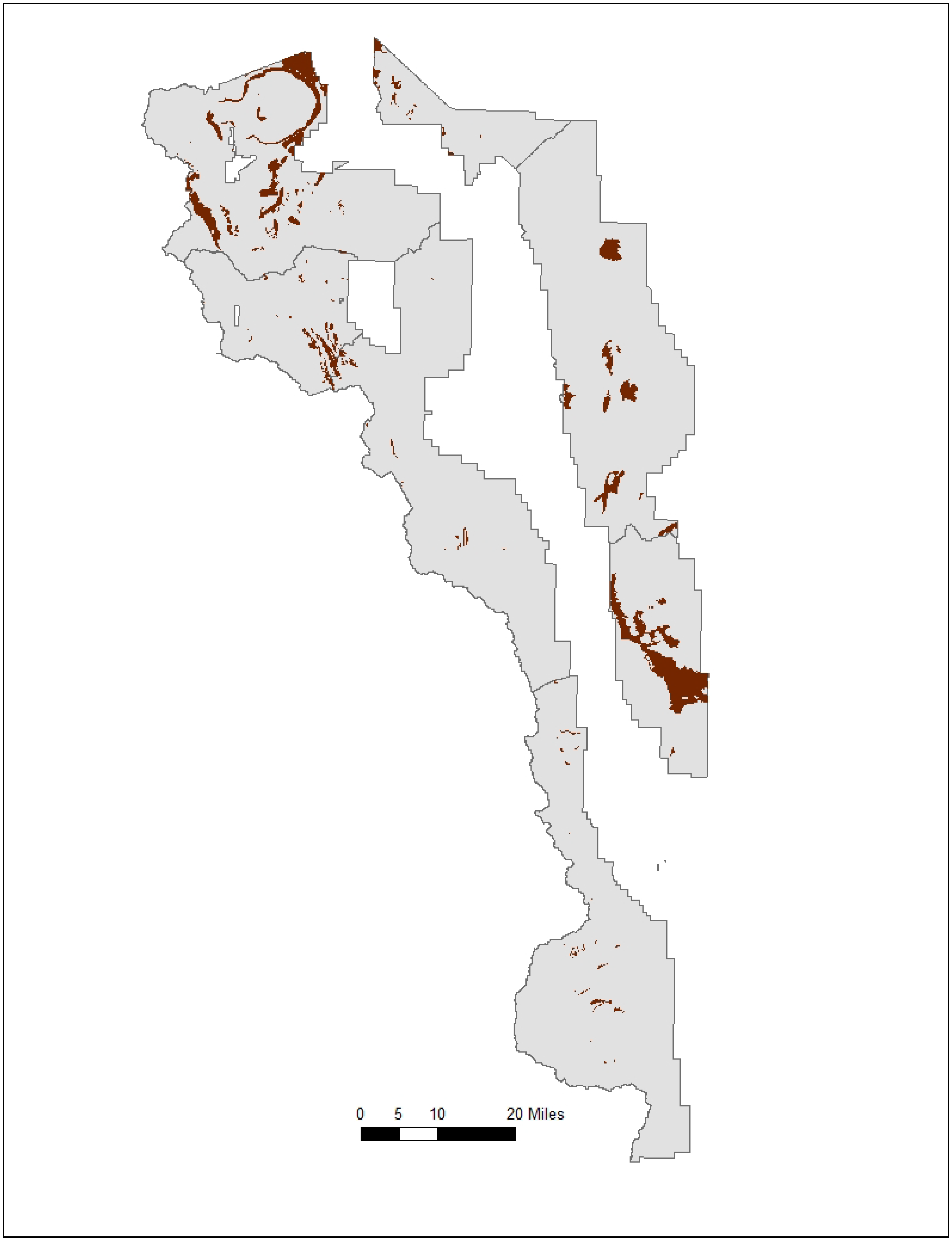



*Figure 22. Distribution of special habitats on the Inyo NF (INF TEUI layer).*

**Indicator 2: Special Habitat Health**

Botanists conducted qualitative field assessments and monitoring visits to a sample of special habitat sites in 2020 and 2021, as part of project surveys, OHV habitat monitoring for SCC plant species and for long-term monitoring of *Abronia alpina* in dry forb habitat in the Southern Sierra. In 2021, botany staff completed botanical surveys and impact monitoring in ~112 acres of special habitat types. No targeted special habitat surveys were completed in 2020 due to COVID-19 restrictions.

*Table 10. Special habitat area surveyed in 2021*

| **Special Habitat (2021 Surveys)** | **Area surveyed (acres)** |
|---|---|
| Dry-Forb | 96.2 |
| Gull Lake roof pendant | 0.2 |
| Limestone | 4.6 |
| Log Cabin Mine roof pendant | 11.2 |
| Metasediment of the Gull Lake roof pendant | 0.2 |
| **Total** | **112.4** |

During the quantitative population monitoring of *Abronia alpina* in 2021, direct disturbance impacts in dry forb habitat were limited to observations of several small fire rings, minor items of trash, and use on existing system trails. No incidents of severe disturbance or patterns of ongoing recreational use in the sub-populations was observed.

In regards to *Abronia alpina*, 2021's total numbers come out to about half of the next lowest year's estimates (27,136 in 2021 vs 54,277 in 1991). This seems mostly due to a combination of lower densities (likely due to the extremely low precipitation during winter 20/21, and also due to more precise mapping. Some of the difference is therefore due to sampling changes, but there were definitely fewer plants. The overall distribution of most subpopulations does not appear to have been reduced, but perhaps has gotten patchier and less dense compared to the previous years monitoring. Where relatively smooth geometry was used to capture the polygons in the past, the polygons captured in 2021 have more complex borders that exclude previously mapped areas. Also, some areas previously mapped as polygons were mapped as a collection of censused points in 2021. Encroachment by conifers into this habitat type was previously mapped in 2015, and additional data collection on conifer encroachment is targeted for 2022.

Surveys for invasive species have occurred in some special habitats but there is not complete coverage and surveys are not completed on a regular basis. Percent of each special habitat with some amount of invasive plant survey ranges from 0-52%, with dry forb habitat (includes pumice flats and *Abronia alpina* habitat) having the greatest amount of survey coverage. Known invasive species occupancy in special habitats does not exceed 1% total cover for any of the types. Highest priority species for management (shown in red in the table below) include Perennial Pepperweed, Canada thistle, Russian Olive, and Tamarisk, in the alkali flat, limestone, and *Quercus kelloggii* special habitat types.

*Table 11. Table showing the percent of special habitats surveyed in 2021 that were found to have invasive priority species.*

| Special Habitat | Special Habitat - Area (acres) | Percent of Special Habitat surveyed for IPS (%) | IPS Max. Extent, All Species - Area (acres) | IPS Max. Extent, Priority 1&2 Species- Area (acres) | IPS Species Present |
|---|---|---|---|---|---|
| ALKALI-FLAT | 9,376 | 50 | 314 | 152 | Bouncing bet, perennial pepperweed, Canda thistle, cheatgrass, dandelion, mullein, curveseed butterwort, fivehorn smotherweed, herb sophia, lenspod whitetop, prickly Russian thistle, Russian olive, tamarisk, saltlover, shortpod mustard, sweetclover, tumble mustard |
| Banded calc-hornfels and pelitic hornfels | 210 | 1 | 0 | 0 | |
| Bloody Mountain formation | 2,174 | 1 | 0 | 0 | |
| Bright Dot formation | 1,207 | 0 | 0.03 | 0 | cheatgrass |
| DRY-FORB | 11,580 | 52 | 34 | 0 | prickly Russian thistle, dandelion |
| eolian - dune field | 1,469 | 0 | 0.01 | 0 | prickly Russian thistle |
| eolian - sand sheet | 2,377 | 0 | 0 | 0 | |
| Gull Lake Roof Pendant | 1,202 | 2 | 2 | 0 | cheatgrass |
| Hornfels | 1,172 | 23 | 42 | 0 | cheatgrass, prickly Russian thistle |
| Limestone | 48,550 | 4 | 872 | 0.2 | cheatgrass, herb sophia, prickly Russian thistle, red brome, redstem stork's bill, tamarisk, sweetclover |
| Log Cabin Mine Roof Pendent | 88 | 31 | 0 | 0 | |
| Marble | 381 | 1 | 0 | 0 | |
| Metasediment of the Bishop Creek Roof Pendant | 39 | 0 | 0 | 0 | |
| Metasediment of the Gull Lake Roof Pendant | 7,032 | 1 | 193 | 0 | cheatgrass |
| Metasediments | 400 | 45 | 5 | 0 | cheatgrass |
| Mount Aggie formation | 1,648 | 0 | 2 | 0 | |
| Mount Baldwin Marble | 1,473 | 4 | 0 | 0 | |
| Mount Morison Sandstone | 554 | 0 | 0 | 0 | |
| Quercus kelloggii | 541 | 33 | 215 | 32 | Arabian schismus, cheatgrass, mullein, desert wheatgrass, herb sophia, Himilayan blackberry, horehound, prickly lettuce, prickly Russian thistle, red brome, redstem stork's bill, ripgut brome, tamarisk, sweetclover, tumblemustard |
| Sand dune deposits | 7 | 0 | 0 | 0 | |
| Sand dunes | 9,035 | 0 | 2 | 0.5 | cheatgrass, prickly Russian thistle, saltlover |
| Seep | 297 | 3 | 0 | 0 | |
| Siliceous calc-hornfels | 480 | 2 | 0 | 0 | |

**Indicator 3: Disturbance Events in Special Habitats**

The majority of OHV trespass and unauthorized routes were documented in dry forb type, followed by limestone habitats. A handful of other types of special habitats had incidences of OHV intrusion and unauthorized routes, but they were relatively limited in number and extent. Major fires affected a significant portion of several special habitat types, such as the 2020 Beach Fire in eolian/sand dunes habitat south of Mono Lake, the 2019 Springs Fire in dry forb habitat, the 2016 Marina Fire in metasediments habitat, and the 2007 Inyo Complex Fire in *Quercus kelloggii* stands.

Utility infrastructure maintenance has resulted in some short term effects to dry forb habitat, in cases where equipment has traveled off system roads to complete pole replacement work. These projects incorporate minimization strategies to travel the shortest distance possible, and disguise tracks and spread vegetation after the work is completed. No other projects have been implemented in the vicinity of or within special habitat types.

*Table 12. Known disturbance in each type of special habitat.*

| Special Habitat | Special Habitat - Area (acres) | Unauthorized Routes - Area (acres) | OHV Trespass - Occurance | Major Fire - Area (acres) | Other Fire - Occurance |
|---|---|---|---|---|---|
| ALKALI-FLAT | 9,376 | 4 | 7 | 46 | 4 |
| Banded calc-hornfels and pelitic hornfels | 210 | 0 | 0 | 0 | 0 |
| Bloody Mountain formation | 2,174 | 0 | 2 | 0 | 1 |
| Bright Dot formation | 1,207 | 0 | 0 | 0 | 0 |
| DRY-FORB | 11,580 | 31 | 310 | 77 | 18 |
| eolian - dune field | 1,469 | 0 | 9 | 0 | 1 |
| eolian - sand sheet | 2,377 | 0 | 0 | 1,561 | 5 |
| Gull Lake Roof Pendant | 1,202 | 0 | 0 | 52 | 2 |
| Hornfels | 1,172 | 0 | 0 | 22 | 2 |
| Limestone | 48,550 | 25 | 57 | 0 | 6 |
| Log Cabin Mine Roof Pendent | 88 | 0 | 0 | 0 | 0 |
| Marble | 381 | 0 | 0 | 2 | 0 |
| Metasediment of the Bishop Creek Roof Pendant | 39 | 0 | 0 | 0 | 0 |
| Metasediment of the Gull Lake Roof Pendant | 7,032 | 0 | 0 | 0 | 1 |
| Metasediments | 400 | 0 | 0 | 65 | 1 |
| Mount Aggie formation | 1,648 | 0 | 0 | 0 | 0 |
| Mount Baldwin Marble | 1,473 | 0 | 0 | 0 | 0 |
| Mount Morison Sandstone | 554 | 0 | 0 | 0 | 0 |
| Quercus kelloggii | 541 | 2 | 1 | 464 | 3 |
| Sand dune deposits | 7 | 0 | 0 | 0 | 0 |
| Sand dunes | 9,035 | 3 | 2 | 0 | 6 |
| Seep | 297 | 0 | 0 | 0 | 0 |
| Siliceous calc-hornfels | 480 | 0 | 3 | 0 | 1 |

## Discussion

Current mapping of special habitat types total just over 100,000 acres, with approximately half of that acreage located in wilderness. The Mono Lake and Mt. Whitney Ranger Districts have higher acreage of special habitat than Mammoth or White Mountain Ranger Districts, but special habitats do occur on all four districts. This inventory will serve as a baseline for comparison in future years. Conclusions about overall trend by habitat type are likely to be less meaningful than trends in condition of specific sites. Given the large extent and variety of special habitats, monitoring will necessarily focus on a sample of sites.

Our review of surveys, invasive plant infestations, fire history, and OHV related impacts highlight certain areas that should be prioritized for further field assessments and management/restoration efforts. Some examples are OHV impacts in dry forb habitat, invasive species in alkali flat and black oak habitats, and fire effects in black oak and eolian/sand dune habitats. In addition, this initial review of the data will be used to prioritize efforts in special habitat types which have had little previous survey and monitoring effort.

While some amount of natural and anthropogenic disturbance are ongoing in a variety of special habitats, the forest plan components (eg TERR-SH-DC-01, 02, 03, and TERR-SH-STD-01) provide rationale for management and restoration that would address these impacts.

### *Recommendations*

No recommendations

## AR02. What is the quality of bighorn sheep winter range?

The indicators associated with this question include acres of vegetation management in the winter range for bighorn sheep and tree cover in winter bighorn sheep range.

### *Relevant Plan Components*

SPEC-SH-DC-01: An adequate amount of suitable habitat supports persistent populations of bighorn sheep.

These habitat patches include **unforested openings** supporting productive plant communities with a variety of forage species and near adequate steep rocky escape terrain throughout the elevational range within mountain ranges. These areas meet different seasonal needs for each sex for feeding, bedding, birthing sites, lamb rearing, and migration routes between suitable habitat patches.

### *Key Results*

Indicator 1: There were no management actions taken in bighorn sheep winter or critical habitat.

Indicator 2: We did not monitor this indicator. Winter habitat is not defined and we did define it independently for this analysis.

### *Recommendations*

- Change both indicators 1 and 2 to include only critical habitat for the Sierra bighorn sheep, not winter habitat.

## AR03. How is the condition of seasonal sage-grouse habitats and connectivity changing?

The indicators associated with this question include sagebrush stand condition from monitoring plots (e.g., cover, species composition) and acres of treatment (e.g., conifer removal, meadow restoration, invasive removal).

### *Relevant Plan Components*

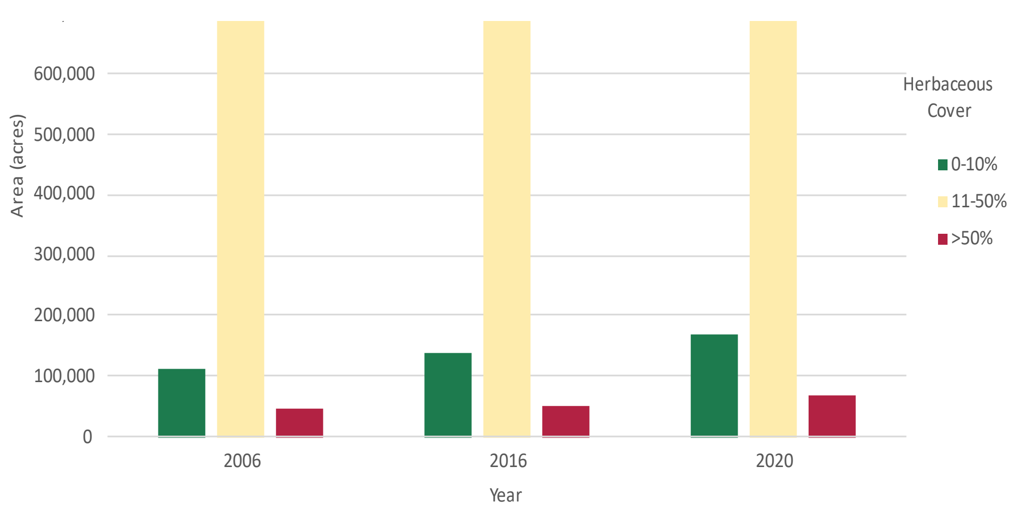
SPEC-SG-DC-01: Suitable sage-grouse habitat includes breeding (nesting), brood-rearing, and wintering habitats that are distributed to allow for dispersal and genetic flow, with land cover dominated by sagebrush. Suitable habitat is predominantly sagebrush shrubland and sagebrush steppe, with associated mesic habitats. Specific vegetation conditions are closely tied to local conditions and ecological site potential.

### *Key Results*

We looked at percent of sage grouse suitable habitat that had herbaceous cover, within the Crowley Basin. Here, we are using herbaceous cover as a proxy for invasive grasses. The results of TE03 and FS01 were used to inform this question. While some herbaceous vegetation is important for sage-grouse forage, a large increase in invasive grasses can lead to much higher than natural fire frequencies and convert sage brush habitat into grasslands, which reduces habitat suitability and connectivity for sage-grouse. Figure 23 shows that areas with very little grass cover have increased, as well as those with over 50% grass cover. Areas with over 50% cheatgrass are of greatest concern, because that is where the risk of frequent fires and ecosystem change drastically increases. Invasive grass cover has not increased dramatically in these areas over the past 14 years, and where it has, it has been small areas, mostly after fires. However, the steady increase in areas with greater than 50% invasive grass cover is a cause for continued monitoring and may indicate a concern is on the horizon.

Sage-grouse habitat connectivity and movement patterns within the bistate populations are not fully understood. Ongoing research may contribute to our understanding and connection between the species and landscape uses. Based on what data we have on sage-grouse habitat selection and movement patterns, the condition of seasonal habitat connectivity is presumed to be decreasing, though as of now, the decrease seems to be minor and it is uncertain whether it is meaningful for sage-grouse population dynamics.

*Figure 23. Invasive grass cover model for suitable sage-grouse habitat within the Long Valley Population Management Unit (PMU)*




**Recommendations**

No recommended changes.

# Theme 4: Visitor Use, Satisfaction, and Progress on Recreation Objectives

## VU01. What are the trends in visitor use and satisfaction?

The indicators associated with this question include visitor use and satisfaction and visitor recreational activity type.

### *Relevant Plan Components*

REC-FW-DC-03 Recreation opportunities provide a high level of visitor satisfaction. The range of recreation activities contribute to social and economic sustainability of local communities.

### *Key Results*

The Forest Service completed a National Visitor Use Monitoring survey in FY21. The data analysis is conducted at the national level and will be available sometime in 2022. The 2023 INF monitoring report will include a comparison between the 2021 survey results and prior studies conducted in 2016 and 2011. The Forest Service expects that changes in visitor use and the limitation of in-person data collection resulting from the pandemic will confound comparison with findings from prior surveys. This is a potential obstacle that we will keep in mind when we evaluate data over time and during the pandemic.

### *Recommendations*

No recommended changes

## VU02. To what extent are trails providing access to the activities as intended?

The indicators associated with this question include total miles of motorized and nonmotorized roads and trails and percentage of miles maintained.

### *Relevant Plan Components*

REC-FW-DC-11: The Inyo National Forest provides a range of year-round developed and dispersed recreation settings that offer a variety of motorized and nonmotorized opportunities and recreation experiences.

REC-FW-OBJ-03: Within 10 years of plan approval, maintain to standard 75 percent of the Inyo's designated trail system.

### *Key Results*

The Inyo NF has 1200 miles of nonmotorized trails and 2400 miles of roads and motorized trails open to motorized recreation. The trail system is used both to access specific recreation destinations like high country lakes as well as to provide for recreation activities like hiking, horseback riding, and off-highway vehicle use.

In 2021, 2.4 miles of new construction or adoption of user-created trails was completed in the Mammoth Lakes Basin to increase options for travel by foot, horse, or bicycle and reduce the need for driving between popular areas within the Basin. This work was planned and implemented in cooperation with the Town of Mammoth Lakes.

Annual maintenance of trails includes clearing fallen trees, removing rocks, cutting back brush, cleaning out drainage dips, and other tasks. Each year, the Inyo works with many volunteers and partners including Inyo County, Town of Mammoth Lakes, Mono County, California Conservation Corps, Eastern Sierra Conservation Corps, Friends of the Inyo, and the Student Conservation Association to accomplish this work on the most popular trails.

In addition, the Forest conducts heavy maintenance on degraded trails as funding allows. This work can include rebuilding foot logs, replacing erosion control structures, repairing retaining walls, and other technical tasks. Heavily used trails typically need this level of intensive maintenance every 5-10 years.

Very little trail work was completed in 2020 due to pandemic restrictions. In 2021, the Inyo NF and partners completed annual maintenance on 470 miles (39%) of non-motorized trails and 161 miles (46%) of motorized trails. The Forest also conducted 6.8 miles of heavy maintenance on the John Muir Trail, Shadow Creek, and Lower Rock Creek trails working with partners.

The miles of trail maintained in 2021 was larger than in past years, mainly due to an increase in partnerships and a focus on hiring Forest staff such as Wilderness Rangers. This increase in partnerships is reflected in this report under question PC04, which shows a three-fold increase in partnerships between 2019 and 2021. Trails partners included:

- California Conservation Corps Backcountry Trails Program
- Eastern Sierra Conservation Corps
- JMT Wilderness Conservancy
- Friends of the Inyo
- Town of Mammoth Lakes
- Mono County
- Pacific Crest Trail Association
- June Lake Trails Committee
- Student Conservation Association

### *Recommendations*

No recommended changes

## VU03. How effective have Forest communications with the public been in considering diverse backgrounds?

The indicators associated with this question include Number and types of public outreach activities and visitor demographics.

### *Relevant Plan Components*

VIPS-FW-DC-04: The diverse backgrounds and needs of visitors are considered in the design of communication and interpretive messages.

### *Key Results*

The Inyo NF completed the year-long National Visitor Use Monitoring survey in 2021. The Forest Service repeats this survey every five years on each national forest. The survey data are processed and analyzed by the USFS Washington Office NVUM program. Demographic data and reporting are not yet available to the Inyo NF. A comparison of forest visitor demographics between the 2016 and 2021 surveys will be included in the Inyo NF forest plan monitoring report for 2023.

In 2021 the Inyo National Forest continued quarterly forums with tribal governments to share information about projects and concerns. Tribal engagement also included field trips to visit project areas such as Coyote OHV routes and proposed mining exploration in Long Valley. The Forest staff worked with local tribes and other partners to host a traditional ecological knowledge (TEK) workshop in the Mono Basin to promote integration of traditional practices like cultural burning into land management.

The Eastern Sierra Youth Outdoor Program, which the Inyo National Forest conducts annually in partnership with the Eastern Sierra Interpretive Association and Eastside Sports, strives to reach a representative youth population, including diversity and different economic backgrounds.

The Inyo increased Spanish language news releases and social media posts in 2021. Leave no trace and recreate responsibly messages have been translated into Spanish. Partners such at the Town of Mammoth Lakes also provide Spanish language signage at some trailheads.

### *Recommendations*

We recognize that indicator 2 is difficult to measure and interpret. We will continue to collect information on consideration of diverse backgrounds in Forest communications. We will also work to identify best available science to better capture the intent of this question; whether we reach diverse communities and allow for equal access to Forest resources.

## VU04. To what extent is designated wilderness being managed to preserve wilderness character?

The indicators associated with this question include wilderness performance measures and elements classification.

### *Relevant Plan Components*

DA-WILD-DC-01: The wilderness character of each wilderness, including the qualities of untrammeled, natural, undeveloped, opportunities for solitude or primitive recreation, and other features of value (e.g., ecological, geological or other features of scientific, educational, scenic, cultural or historical value specific to each wilderness area) are preserved and, when possible, enhanced.

### *Key Results*

The Inyo NF, working with the USFS Region 5 wilderness program staff and partner organizations, is in the process of establishing wilderness character baseline condition assessments for all nine wildernesses on the forest by the end of 2023. The baseline assessment for the Hoover Wilderness is complete which sets the initial condition for wilderness character monitoring over the next five years. The other eight wildernesses wholly or partially on the Inyo are at various stages in the process. Once the baseline condition assessment is complete, wilderness character monitoring will occur on a five-year cycle to eventually establish a long-term trend in wilderness character for each wilderness on the forest.

### *Recommendations*

Report on this monitoring only in every 3rd monitoring report cycle (every six years) since data are only going to be collected every five years. Report on this question in the next reporting cycle (2023), since we should have data for the remaining 8 wilderness areas by then, and then again in 2030, 2036, etc.

## PC04. To what degree is the national forest using partnerships to provide additional capacity for visitor services?

The indicators associated with this question include the number of agreements with partners by activity type that are supporting visitor services and the number and type of projects completed with partners.

### *Relevant Plan Components*

VIPS-FW-DC-01: The Inyo has a network of dependable partners and volunteers who provide additional capacity to effectively and efficiently meet plan desired conditions and deliver services to the public.

### *Key Results*

Volunteers and partners are an important part of the Inyo NF visitor services program. Contributors assist with many tasks including trail maintenance, visitor education, interpretive presentations, campground hosting, archeological site surveys, wilderness campsite restoration, trash removal, sign installation at recreation sites, visitor use monitoring, and other activities. In summer 2019, the Inyo NF added a part-time volunteer coordinator to the staff. This increased capacity allows more focus to be placed on developing partnerships and recruiting volunteers. The volunteer coordinator also improved the reporting of volunteer accomplishments.

In 2019, the year the Forest Plan was signed, the Inyo was gaining ground on the use of volunteers and partners. However, in 2020, the Covid-19 pandemic shut down many projects and limited peoples' ability to help the Inyo as they had in the prior year (Table 13). Some work was completed after partner organizations and the Forest Service developed effective safety protocols for field projects to continue. In summer 2021, volunteer and partner activities bounced back and exceeded 2019 levels. The forest was successful in obtaining additional funding through grants and the Great American Outdoors Act to put more partner crews to work on projects like trail maintenance. The increase in the number of partner projects resulted in nearly triple the value of contributed time compared to 2019 and almost five times the value in 2020.

*Table 13. Volunteer and Partner Contributions 2019-2021*

| | 2019 | 2020 | 2021 |
|---|---|---|---|
| # volunteers & partner personnel | 852 | 228 | 863 |
| Volunteer & partner hours | 32,778 | 18,949 | 85,630 |
| Value of contributed time | $833,545 | $514,413 | $2,443,880 |
| # individual & group volunteer agreements | 33 | 25 | 37 |
| # partner agreements | 6 | 6 | 17 |

### *Recommendations*

The monitoring indicators should be revised to better align with the categories of data available through the VSReports system. The activity type data proved to be inconsistent due to the large number of categories in VSReports. Many of these categories are not mutually exclusive, leading to poor comparability of data from year to year. Recommended changes:

> Indicator 1. Number of agreements with partners~~, by activity type,~~ that are supporting visitor services.
>
> Indicator 2. ~~Number and type of projects completed with partners. Activity types are defined in VSReports.~~ Number of volunteers, partner personnel, hours contributed, and value of contributions by partners that are supporting visitor services.

# Theme 5: Climate change and other stressors

## CC01. How are high-elevation white pines responding to the effects of climate change and other stressors?

The indicators associated with this question include: (1) spatial extent, by forest type, (2) tree mortality, incidence of insects, disease, and pathogens, and (3) spatial extent of tree regeneration.

### *Relevant Plan Components*

- TERR-MONT-DC 03: At the landscape scale, white pines (such as western white pine) are healthy and vigorous with a low incidence of white pine blister rust. Individual trees and the stands they occur in are resilient to moisture stress, drought, and bark beetles. White pine blister rust-resistant trees are regenerating and populations are sustained.
- TERR-ALPN-DC-03: Subalpine woodlands are resilient to insects, diseases, fire, wind, and climate change. High-elevation white pines (whitebark pine, Great Basin bristlecone pine, limber pine, and foxtail pine) are healthy and vigorous, with a low incidence of white pine blister rust, and resilient to moisture stress and drought. White pine blister rust-resistant trees are regenerating and populations of high elevation white pines have the potential to expand above the tree line.
- TERR-ALPN-DC-04 Mature cone-bearing whitebark pine trees are spatially well distributed to produce and protect natural regeneration and conserve genetic diversity.

### *Key Results*

A Conservation Strategy for whitebark pine in California (USDA and USDOI 2020) summarizes the current science information on the status of whitebark pine in Region 5.

A whitebark pine monitoring plot network was established across Region 5, including the Inyo National Forest, in a joint effort by the R5 Remote Sensing Lab and R5 Ecology Program. During 2014-2019, 112 field plots (0.1 - 0.2 acres) were sampled on the Inyo National Forest as a part of that network, and relevant results are reported below and summarized in more detail in Meyer et al. (2020, in prep.).

The monitoring guide associated with this Inyo National Forest Plan monitoring program specified that outputs from the R5 Remote Sensing Lab $F^3$ product may be used as an extra source of information to map spatial extent of high elevation pines. However, because FIA inventory plots are used as an $F^3$ input, and whitebark plots have not been resampled within the last 5 years, this method is reserved to be potentially included in future monitoring reports.

Similarly, it is recommended that FIA plot data be removed as a data source for forest-level reporting of high elevation pine health. This is because of the relatively low frequency (10-year cycle) of sampling of high elevation pines, relative scarcity of plots within this vegetation type, and limited health information available from the surveys. An additional data source suggested for addition to the INF Monitoring Guide is Ecosystem Disturbance and Recovery Tracker (eDaRT) outputs. We have included summaries of that data source for this report.

## Data

The confidence in the data based on the quality and quantity of the data collected is described under the Results Discussion section.

### Indicator 1. Spatial extent

Table 14 displays the acreage of high elevation forest types. The R5 Existing Vegetation map and Calveg classification product for the Inyo NF, last updated in 2008, was used for acreage of foxtail, bristlecone, and limber pine. The 2020 R5 Remote Sensing Lab Whitebark Pine Distribution Map was used for acreage of whitebark pine (Figure 23); this map represents the presence of whitebark pine as a species. Maps for other white pine species represent Calveg classified forest types (Figure 24); species distribution maps similar to that for whitebark are not currently available for other white pines on the Inyo NF, so these acreages likely underestimate the spatial extent for each species. For example, although western white pine is known to occur on the forest, no stands have been mapped as that type in Calveg. Canopy cover or stand size may not meet Calveg mapping criteria, or some trees may have been misidentified as other conifer species. In either case, the monitoring guide does not specify reporting for western white pine, so this information is provided as additional background.

*Table 14. Acreage of each white pine dominated high elevation forest type from the R5 Existing Vegetation (EVeg) map. Western white pine type is not included due to its absence from EVeg data.*

| Forest type | Acres |
| --- | --- |
| Whitebark pine | 130,053 |
| Foxtail pine | 30,178 |
| Bristlecone pine | 18,448 |
| Limber pine | 10,517 |
| Western white pine | 0 |

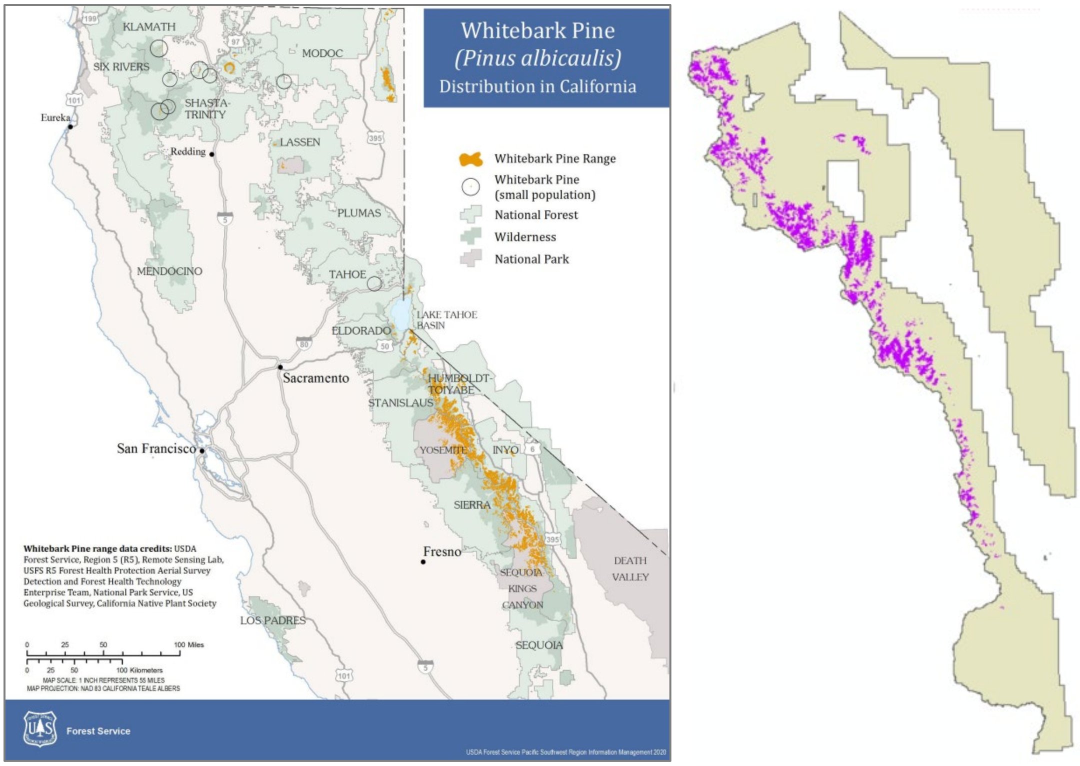



*Figure 24. Whitebark pine distribution map for California (USFS Region 5 Remote Sensing Lab, 2020; left panel) and for the Inyo National Forest (right panel).*

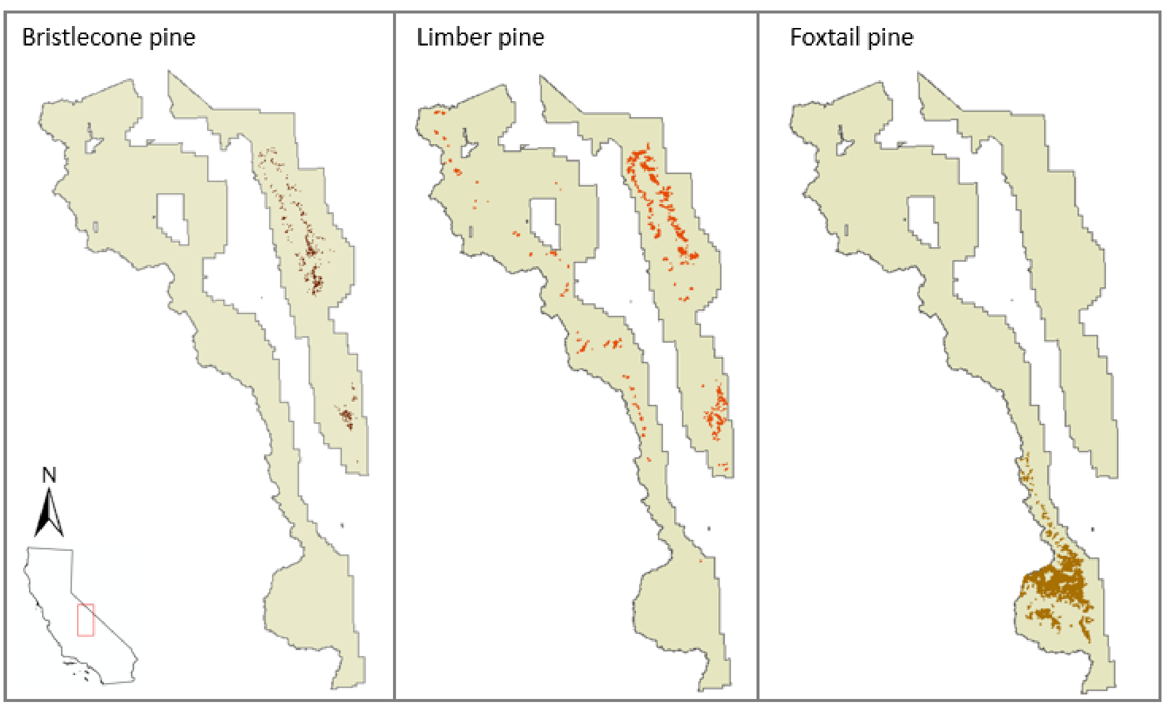



*Figure 25. Maps of bristlecone pine, limber pine, and foxtail pine forest types on the Inyo NF, based on the most recent Calveg dataset (USFS Region 5 Remote Sensing Lab, 2008).*

Indicator 2. Tree mortality, insect, and disease.

Figure 25 illustrates tree mortality trends caused by insect and disease, as reported by R5 Aerial Detection Surveys (ADS) over time. Data are presented for each host species within each respective forest type. The method used by the ADS program changed in 2019 to include the % of the area reported that is affected by disease agents. Importantly, ADS also reports the number of trees per acre per polygon that were estimated to have died. This allows a calculation of incidence in terms of total number of trees that died. Only the acreage is presented in this report, because it better represents mortality incidence at the stand and forest type scale, as was intended for this indicator.

ADS Data: acreage of insects, disease, and pathogens 2010-2019

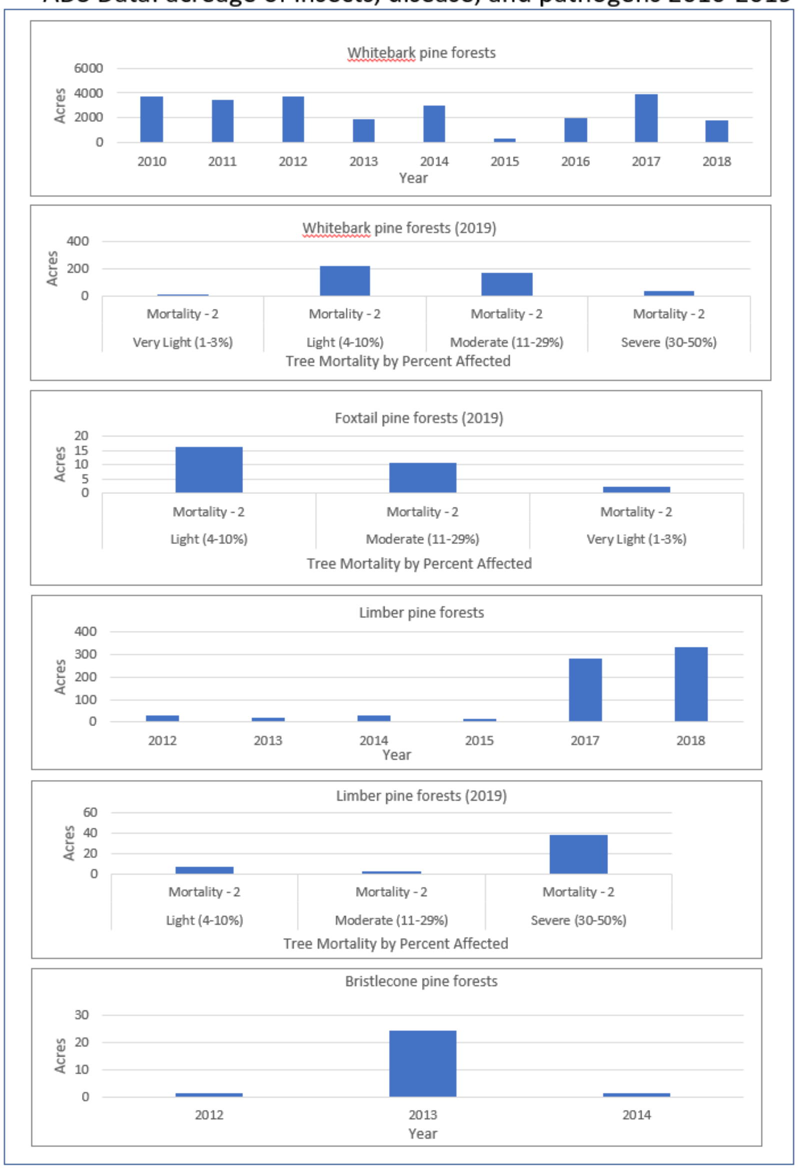
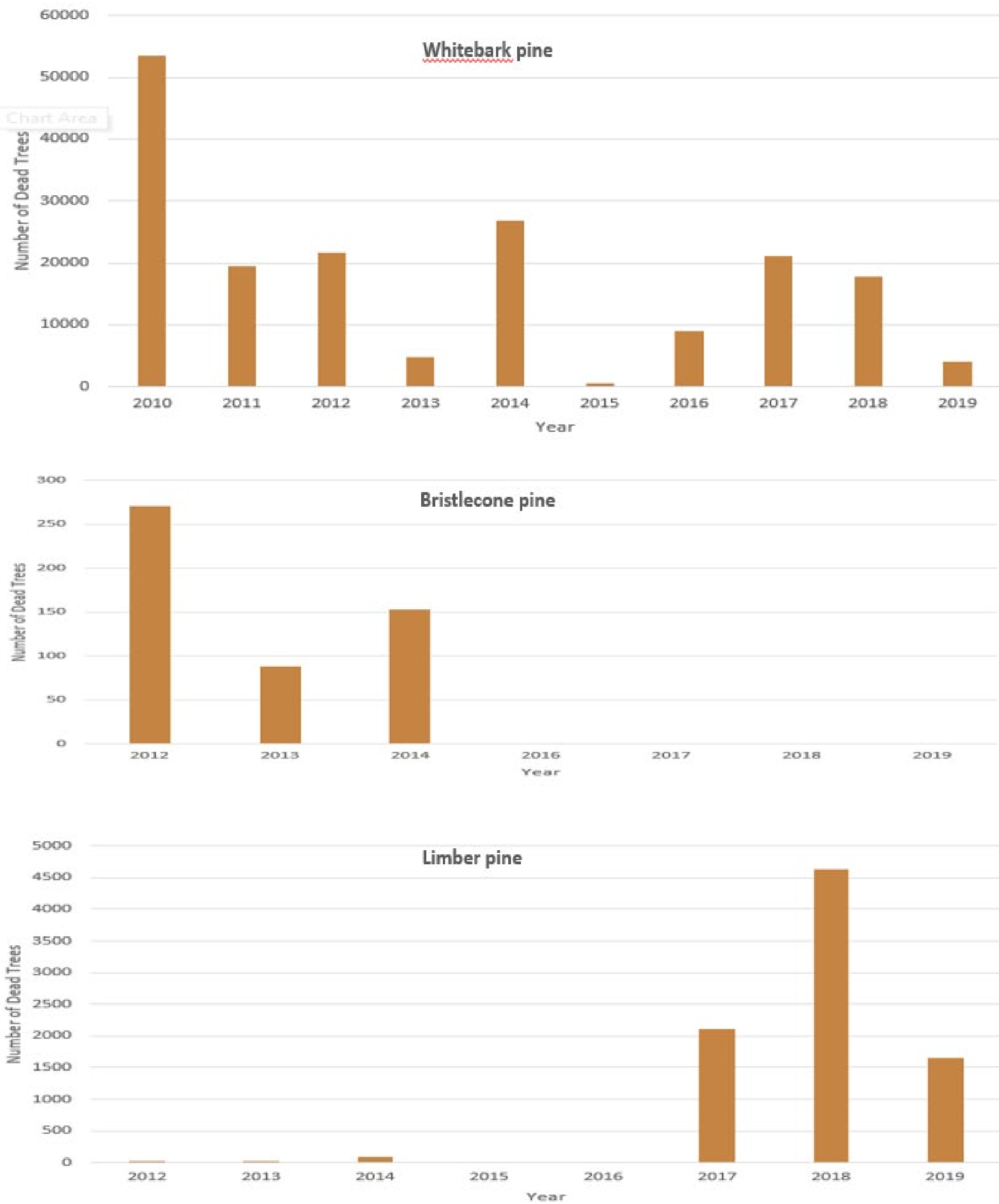



*Figure 26. Aerial Detection Survey (ADS) results for acreage of mortality in white pine forests on the INF for years 2010-2020.*

ADS Data: number of dead trees per species of white pine 2010-2019




**Foxtail pine** (No foxtail pine trees reported dead by ADS for any year)

*Figure 27. Aerial Detection Survey (ADS) results for number of dead trees for each white pine species on the Inyo NF for years 2010-2020.*

Tree mortality trends were also analyzed using eDaRT, a dataset that provides outputs of canopy cover loss at 30 m scale for the entire forest for each year, but at this time does not provide attribution for disease agent. Figure 26 displays results for each white pine species for each year 2010-2020.

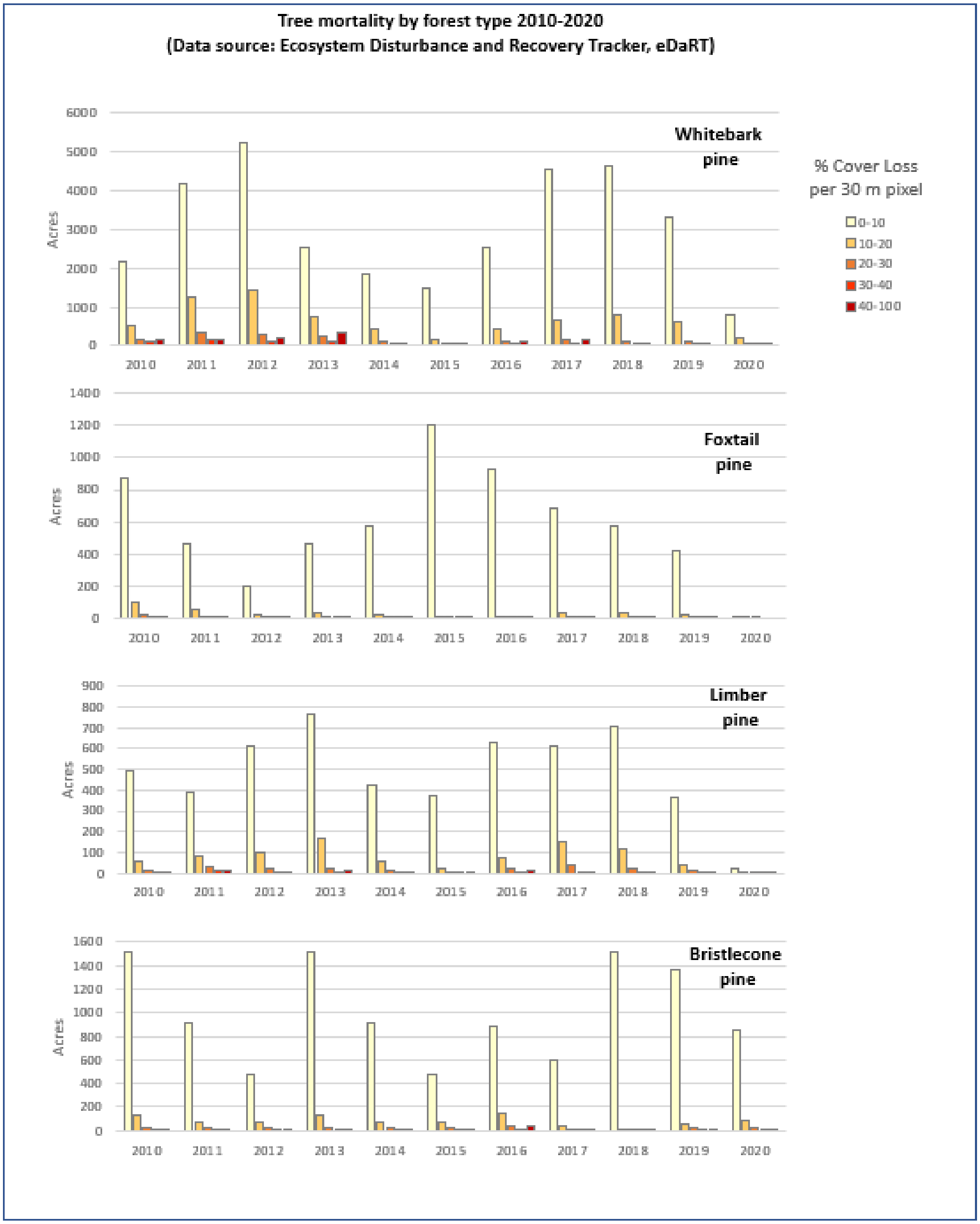



*Figure 28. Ecosystem Disturbance and Recovery Tracker (eDaRT) tree mortality detections for white pines, binned by % canopy cover loss per 30 m pixel, by forest type, in years 2010-2020.*

Indicator 3. Spatial extent of tree regeneration

The field plot dataset sampled 2014-2019 on the Inyo NF included counts of young (<5 years old) white pines that represent recruitment resulting from presumed sexual reproduction (Table 15, Figure 28).

Total counts of seedlings (< 1 inch dbh) and saplings (<3 inch dbh), regardless of age, were also counted. Particularly in whitebark pine, older seedlings and saplings often represent asexual reproduction. These stems typically result from layering in krummholz mats, or from basal sprouts that may grow into upright, cone-bearing stems.

*Table 15. Mean (± standard error) white pine tree regeneration densities (numbers of seedlings and saplings per acre) in the Inyo National Forest white pine monitoring plot network. Each plot was sampled once during years 2014-2019.*

| Species | No. plots | Young seedlings (<5 years) per acre | Seedlings and saplings (all ages) per acre |
|---|---|---|---|
| Whitebark pine | 112 | 25 ± 5 | 285 ± 40 |
| Foxtail pine | 9 | 10 ± 5 | 45 ± 15 |
| Limber pine | 18 | 0 ± 0 | 25 ± 5 |
| Bristlecone pine | 12 | 0 ± 0 | 20 ± 10 |
| Western white pine | 6 | 20 ± 15 | 50 ± 25 |

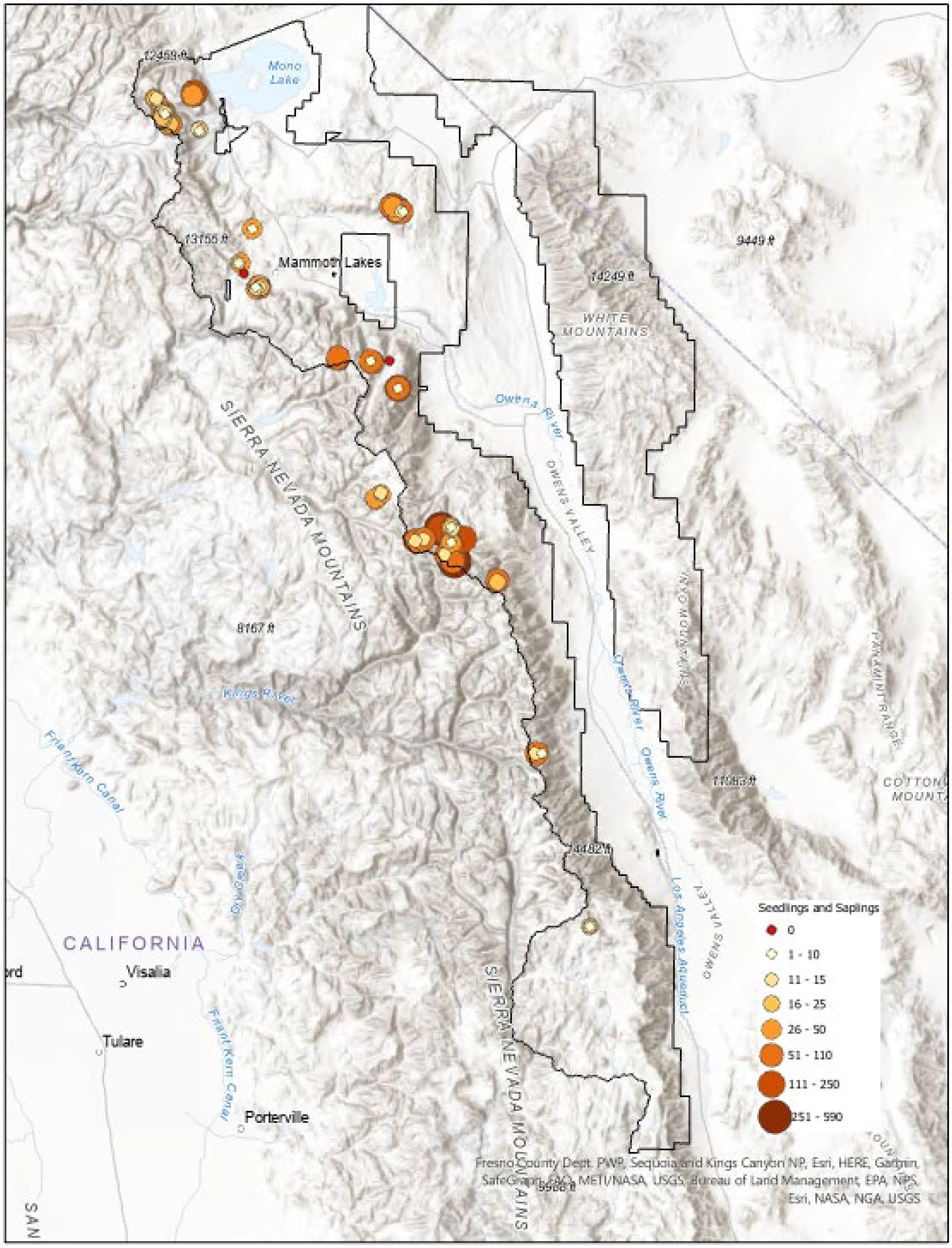



*Figure 29. Whitebark pine young seedling distribution within INF monitoring plots (count per 0.2 acre plot of seedlings less than 5 years in age).*

## Results Discussion

### Indicator 1. Spatial extent

The Calveg product was last updated on the Inyo NF in 2008. Previous versions (prior to 2008) were developed using limited aerial photography and satellite-based imagery resources, resulting in limited confidence to interpret trends prior to that, especially for open-structured, subalpine stands, often with mixed species composition. Therefore, for this report, accurate trends in total area over time were not available. As a proxy for trend in spatial area, the monitoring guide specifies that the Ecosystem Disturbance and Recovery Tracker (eDaRT; Indicator 2) be used to approximate change. Using this method, trends and data confidence for the spatial extent of white pines during this analysis period differ by species.

For whitebark pine, the most recent distribution map indicates this species does not occur in some areas of the south Sierra where it had been previously mapped. This change is due to previous mapping error, as confirmed in the field, and not due to a change in spatial extent. Elsewhere, according to eDaRT outputs, approximately 5000 acres of whitebark pine forest (4%) had cover loss greater than 20% during years 2010-2020, out of a total of ~130,000 acres total forestwide. Approximately 30,000 acres (23%) of whitebark pine forest had cover loss of 10% or less during that time period.

Despite these losses, there does not appear to be a declining trend in the spatial extent of whitebark pine because regeneration is generally occurring in areas of forest mortality. For example, tree mortality in 2010 caused by insect and disease was mainly localized on and near June Mountain. Tree regeneration is occurring within these stands (Meyer et al. 2016), although continued monitoring will be required to determine if reproductive success will continue. Locations where tree mortality in recent years has been coupled with a lack of regeneration can be found on Mammoth Mt. and at Saddlebag Lake. In these localities, the spatial extent of whitebark pine may become reduced if these trends continue. These findings are consistent with recent research documenting recreational impacts to whitebark pine recruitment once impacts reach certain thresholds of severity (Slaton et al. 2019a).

For foxtail and bristlecone pine, there is no apparent trend in spatial extent over time. The levels of loss as indicated by eDaRT are mostly sparse (<10% cover loss), and those changes are not localized to certain locations within the range.

For limber pine, data indicate a potential loss in spatial extent over the analysis period. eDaRT outputs mapped approximately 1000 acres (10%) of limber pine forest that experienced loss of more than 20% cover over the analysis period, and that approximately 4000 acres (38%) lost 10% cover or less. Considering that limber pine forest is mapped for only 10,517 acres on the INF and that recent recruitment is extremely limited (see Indicator 3), there appears to be a declining trend for spatial extent of limber pine.

Improved spatial and temporal resolution of map products, including methods to resolve species identifications will be needed to address trends in future reports. In addition, potential recent recruitment of young seedlings into new habitats (meadows or shrublands) may be occurring, but neither field nor remote sensing datasets currently track these potential shifts.

### Indicator 2. Tree mortality, insects, and diseases.

The Inyo National Forest Monitoring Guide specifies that tree mortality be assessed for white pine forest stands. However, in contrast to a species-based approach, tree mortality and disease agents based on remote sensing (ADS, eDaRT) data may capture non-target species in stands with mixed species composition. Consequently, we cannot definitively assign tree mortality to a specific species in mixed species stands, but rather to a broader forest type that may or may not indicate mortality in our target species (i.e., high elevation white pines).

*Aerial Detection Survey (ADS) results:*

Within the whitebark pine forest type, mountain pine beetle was the primary disease agent reported by ADS. In addition, some acres were reported to be affected by Ips engraver beetles and western pine beetle in 2012 and 2018, respectively. No white pine blister rust was reported on the INF.

For foxtail pine forest type, reported disease agents in 2019 included pinyon Ips, fir engraver, mountain pine beetle, and Jeffrey pine beetle. No disease was reported by ADS for any year within the foxtail pine forest type in years 2010-2018.

For limber pine, mountain pine beetle was the only reported disease agent for limber pine as a species. However, for other trees present within the limber pine forest type, a wide range of disease agents was reported, ranging from gelechiid moth, Marssonina blight, to fir engraver. These disease agents affect the other tree species that often co-dominate where limber pine is present.

For bristlecone pine forest type, mountain pine beetle was the only disease agent reported by ADS for years 2002-2004. No disease was reported by ADS for the host bristlecone pine in 2019. For some years 2005-2018, ADS flights were not conducted for the White-Inyo Mts., but the surveys that did occur documented no mortality.

It is important to note that although ADS flights were conducted on the INF for each of the analysis years, that in some years, the entire forest was not always flown. Therefore, acreage summaries reported in this document may underestimate acreage that would have been reported if flight coverage were complete. However, overestimates in the size of ADS polygons have also been documented during the recent drought (Slaton et al. 2021). The finer spatial resolution of eDaRT data suggests this may have been the case for some ADS polygons representing large mortality patches.

*Ecosystem Disturbance and Recovery Tracker (eDaRT) results:*

eDaRT outputs indicated that for whitebark pine, canopy cover in denser forests was lost primarily during events 2010-2013, during the tree mortality event that was mostly localized to June Mt. and surrounding areas. Background levels of mortality (< 10% canopy cover loss) were also high then, and spiked again in the years following the extreme drought that peaked in 2014 to 2016.

For foxtail pine, tree mortality has been limited to lower “background” levels, almost exclusively with canopy cover loss less than 20%, and losses peaking post-drought.

Tree mortality in limber pine has been fairly consistent 2010-2019. Most loss occurred in the Sierra Nevada, and both ADS and field surveys indicate mountain pine beetle and drought as the major drivers. As noted above, of all the white pines, limber pine is the most limited in spatial extent (10,517 acres), and therefore had the greatest proportional loss of cover during the analysis period.

Bristlecone pine exhibited a similar temporal trend as limber pine over the analysis period, but levels of canopy cover loss were much lower, rarely more than 10%. Only a single tree was observed in the field to be affected by mountain pine beetle. Other causes of canopy cover loss have been attributed to fungal disease, although many trees are able to compartmentalize the damage and survive these attacks (MacKenzie, 2019).

### Indicator 3. Spatial extent of tree regeneration

More than 250 young whitebark pine seedlings per acre were recorded in the Log Cabin/Boy Scout Camp area above Lee Vining, and in the Green Lake vicinity of Bishop Creek. No young seedlings were found in the plots on the western portion of Mammoth Mt., on Wheeler ridge, or in the southern-most population at Chicken Spring Lake, south of Mt. Whitney (Figure 28).

Areas with more than 1000 whitebark pine seedlings and saplings of any age per acre were found in the Bishop Creek drainage, near Green Lake, Saddlerock Lake, and on Table Mt. Plots on the western portion of Mammoth Mt. and at Saddlebag Lake near Tioga Pass were the only plots with no seedlings or saplings.

Foxtail pine was present in 9 plots sampled in the whitebark pine network on the INF, from Onion Valley to Muah Mt. In contrast to whitebark pine, foxtail pine regeneration was predominantly single-stemmed seedlings in forest clearings, uncommonly occurring as basal sprouts (i.e., presumably resulting from asexual reproduction) or krummholz.

Limber pine was present in 24 plots sampled as part of the whitebark pine network. However, 18 plots of that network were specifically targeted to ensure that they contained limber pine and are reported on here. These included 3 plots each in the Middle Fork and South Fork of Bishop Creek, Ash Creek, Death Canyon, and Muah Mt. in the South Sierra, and lower Glass Mt. A total of 2 young seedlings (<5 years in age) was found in all the Bishop Creek plots, and a single young seedling was found in the South Sierra plots, and none in the Glass Mt. plots. For seedlings, saplings, and basal sprouts of any age, the mean count was 25 ± 5 stems per acre for all 18 plots.

No young seedlings of bristlecone pine were found in the 12 plots measured in the White and Inyo Mts. The seedlings and saplings of any age were localized mostly in plots north of Schulman Grove.

Western white pine was present in 6 plots sampled in the whitebark pine network on the INF, on the western side of Mammoth Mt. and near Deadman Pass. Most western white pine seedlings and saplings were found on open slopes with rocky or bare mineral soil.

### Summary of Results Discussion:

Each of the three indicators for white pine forests – spatial extent, tree mortality, and regeneration – should be considered together to provide a picture of white pine forest health. These indicators interact with each other and were analyzed in some cases using common data sources.

Trends between the two data sources (ADS and eDaRT) for tracking tree mortality caused by insect and disease are generally similar. Both indicate some canopy loss in whitebark pine covering over 10,000 acres (cumulatively) prior to the drought that peaked in 2014 to 2015 and following the 2012-2016 drought. Tree mortality levels in foxtail pine forests remained low throughout the analysis period. The low levels of loss detected by eDaRT in foxtail (i.e. mostly <10% canopy cover per 30 m pixel) likely represents background tree mortality not recorded by the coarser-scale sampling approach of ADS. In limber pine, tree mortality persisted through the analysis period, as shown by both datasets, with limber pine. It is important to note that the similar patterns are due in part to the difficulty in discerning whitebark from limber pine using either airborne or satellite-based methods. Therefore, interpretations for those two species should be approached with caution. Nonetheless, field observations confirm continued loss of limber pine in years 2010-2020, generally progressing upward in elevation into mixed stands with whitebark pine. Although these results aren't alarming, future monitoring will be critical to indicate if mortality continues to increase.

Outbreaks of native insects have been documented in subalpine forests of the Sierra Nevada throughout the last century, although little is known about past outbreak size and frequency. Meyer and North (2019) reported that outbreaks on the INF prior to the one that affected June Mt. were likely within the Natural Range of Variability (NRV). However, the projections reported by those authors are consistent with the findings reported here of recent elevated mortality in whitebark and limber pines, which may be outside the NRV and associated with declining ecological integrity of whitebark pine ecosystems in California (Meyer et al. 2020), as well as beyond levels anticipated within the Forest plan assessment.

Conditions of whitebark pine stands were evaluated across California state using a combination of the USFS monitoring plot network, plus data from the National Park Service and US Geological Survey (Slaton et al. 2019b). Compared to four other ecoregions in the state (Warner, Cascade-Klamath Mts., Central Sierra, and western slope of the Sierra), the east-side ecoregion ranks second for density of young (<5 yr) seedlings per plot. However, seedlings and trees in the east-side ecoregion, including the Inyo NF, frequently co-occur with the slightly more shade tolerant lodgepole pine (*Pinus contorta*), with the latter out-competing whitebark pine in some settings. Nonetheless, statewide whitebark pine surveys focused on USFS lands conducted by Meyer et al. (2020) concluded that 87% of whitebark pine stands in the eastern Sierra Nevada are dominated by whitebark pine and only 6% of stands contain regeneration dominated by shade-tolerant species or lodgepole pine

### *Recommendations*

- Indicators should have minor alterations, to keep up with the best available science. These include removing FIA as a data source for indicator 2, and replacing it with eDaRT data, since data collection is more frequent and the information collected is more robust.
- For more effective monitoring to inform Forest management, proposed changes include conducting more focused surveys of whitebark and limber pine and conducting effectiveness monitoring in whitebark pine stands receiving management treatments (e.g., mechanical thinning on June Mountain) to evaluate the effectiveness of treatments for reducing mortality or enhancing regeneration.
- Consider the application of restoration treatments in additional targeted whitebark pine stands to increase their resilience to stressors

## CC02. What changes have occurred to the timing, amount, and duration of natural and managed runoff into the national forest's waterways?

The indicators associated with this question include annual in-stream flow regime for selected waterways (not those regulated by the Federal Energy Regulatory Commission).

### *Relevant Plan Components*

WTR-FW-DC-01: Adequate quantity and timing of water flows support ecological structure and functions, including aquatic species diversity, and riparian vegetation. Watersheds are resilient to changes in air temperatures, snowpack, timing of runoff, and other effects of climate change.

*Key Results*

**Indicator 1: Annual Runoff**

- Annual runoff for the Eastern Sierra is divided into two basins: the Owens River Basin and the Mono Lake Basin (Figure 29).
- Data were collected back to 2009, which was the earliest date on record on LADWP's website. Data show that for the thirteen years on record, annual runoff has varied from a low of 148,600 acre-feet to a high of 801,900 acre-feet for the Owens River Basin (Figure 30). Similarly, the Mono Lake Basin had a low of 30,400 acre-feet and a high of 238,800 acre-feet (Figure 31).
- To adequately capture climate change and its effects on runoff, larger datasets are needed.

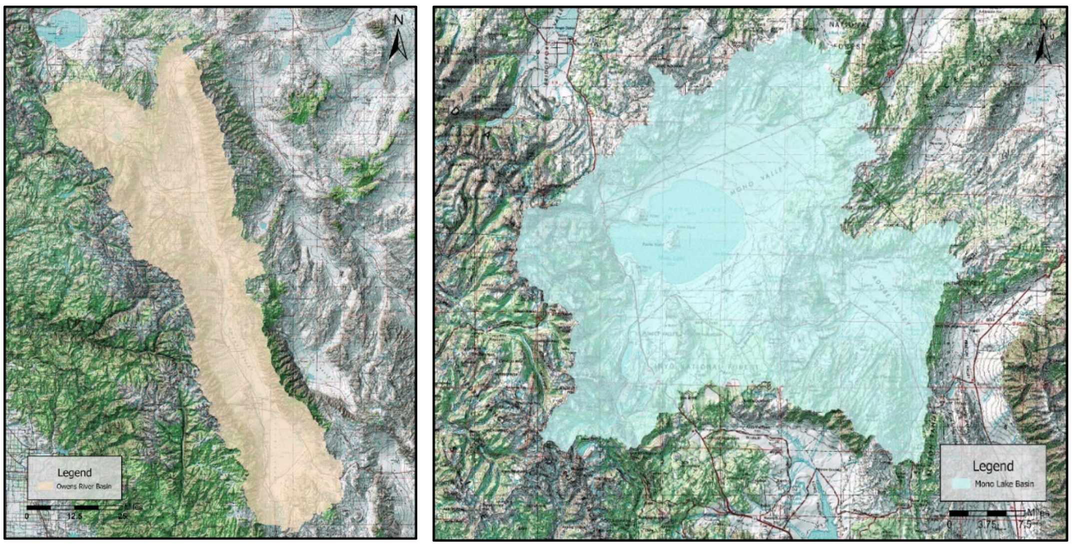



*Figure 30. The Owens River Basin (left) and the Mono Lake Basin (right).*

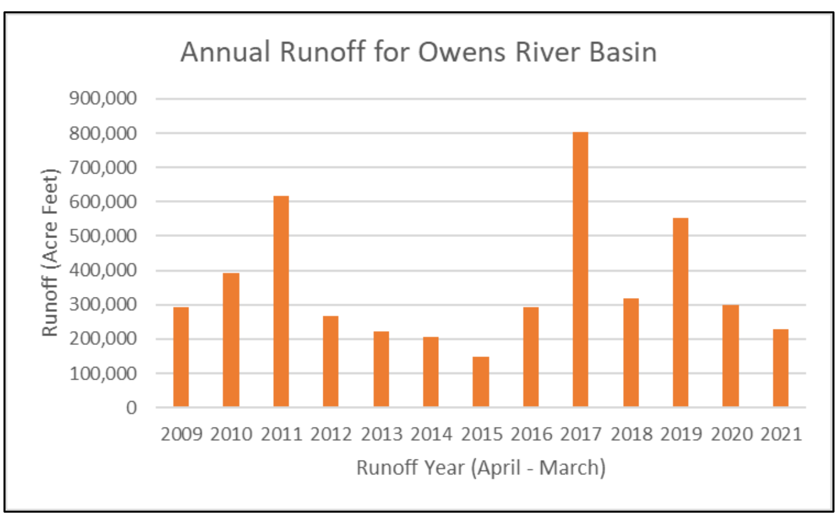



*Figure 31. Owens River Basin annual runoff.*

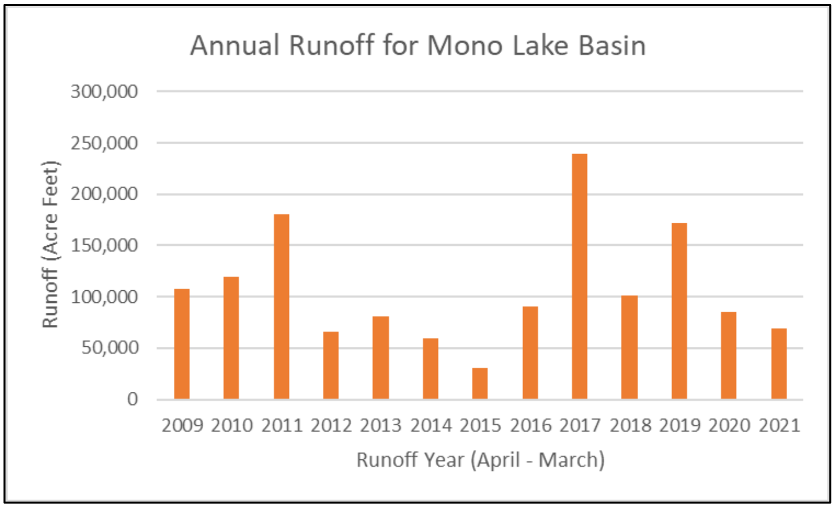



*Figure 32. Mono Lake Basin annual runoff.*

**Indicator 2: Annual In-stream Flow**

- To try and capture the potential impacts of climate change on the timing and duration of flows, both the center mass of runoff and the highest daily mean flow was calculated for each watershed.
- Due to time constraints, two streams with undisturbed watersheds were chosen to represent flows coming off the Forest. The two streams are: Parker Creek and McGee Creek, with Figure 32 displaying the watershed for Parker Creek.
- Even with a rather small dataset, there is a slight trend toward both the “highest daily mean” and “center mass of runoff” occurring earlier (Figure 33 and Figure 34). This is observed with the trendline shifting higher to the left. This basically means that snow is melting earlier, and the streamflow peaks earlier, and recedes earlier. There is lower flow in later summer as a result.

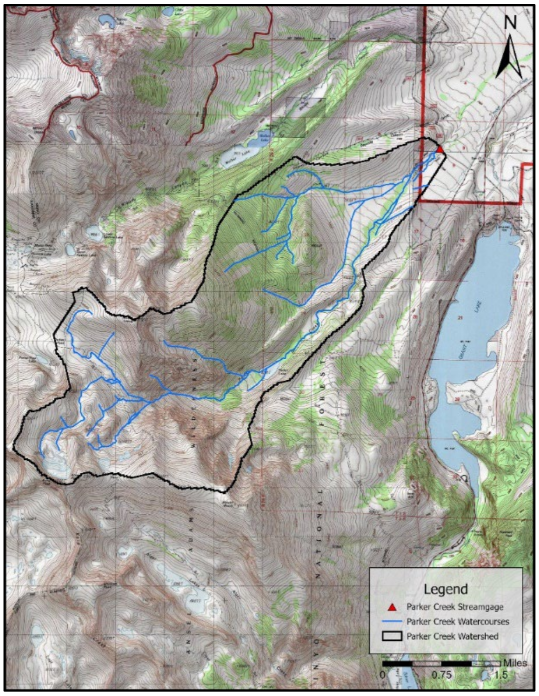



*Figure 33. Parker Creek streamgage site and contributing watershed.*

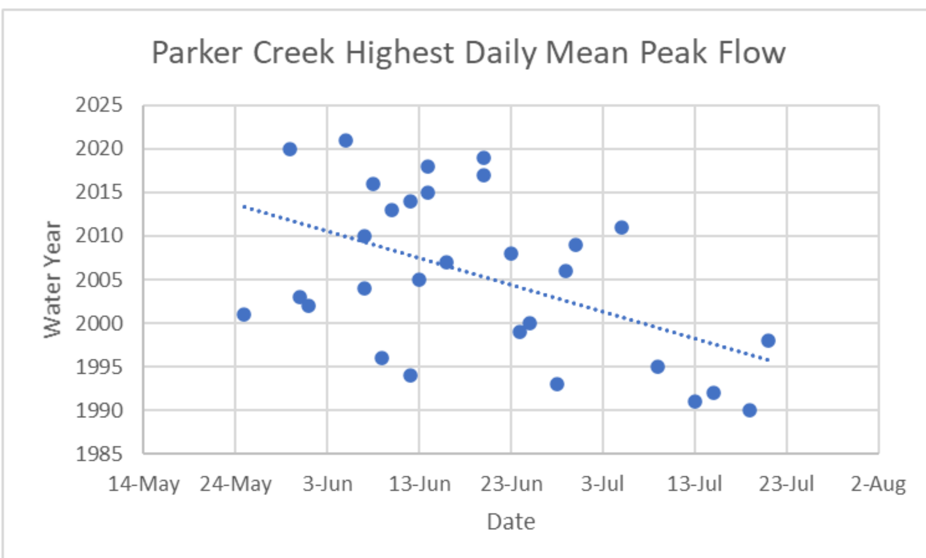



*Figure 34. Highest daily mean for the Parker Creek with trendline. Graph represents 30yrs of flow data going back to 1990.*

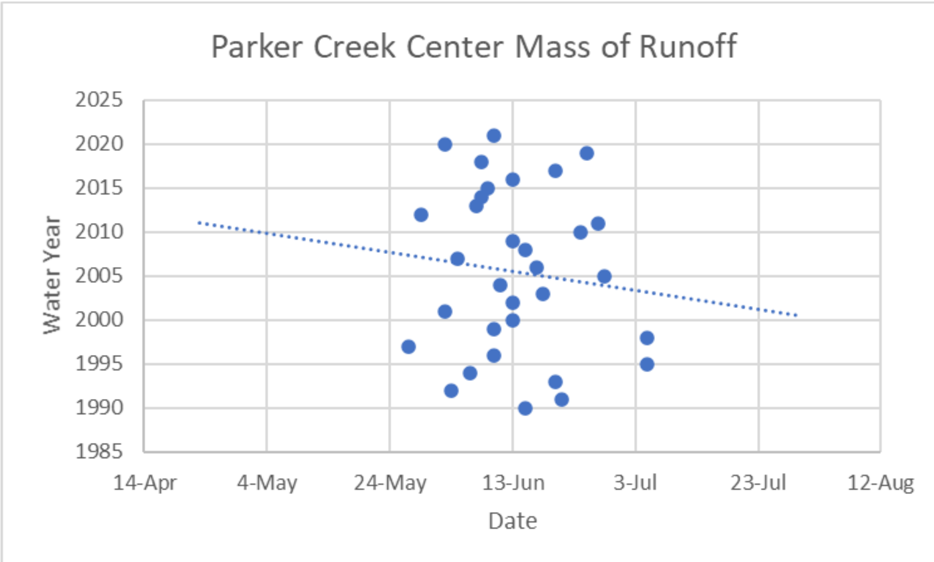



*Figure 35. The center mass of runoff for Parker Creek with trendline. Graph represents 30yrs of data going back to 1990.*

**Summary**

As climate change progresses, it's thought that total annual runoff from the Sierra Nevada will lessen as droughts become more persistent, punctuated by extremely wet years (Swain et al. 2018). Predicted changes in annual runoff would be prolonged years of low annual runoff, followed by a year or two of high runoff. This was demonstrated during the 2012 to 2016 drought followed by the extremely wet 2016/2017 winter. By collecting and analyzing more data, a better trend can be established showing how climate change is impacting annual runoff.

Similar to climate changes impacts on annual runoff, it's also expected that climate change will impact the timing and duration of instream flows. As the snowpack diminishes with a warming climate and precipitation occurs more in the form of rain versus snow, a shift in the center mass of runoff and highest daily mean should occur. These shifts should start to occur earlier in the water year as the slow release of meltwater from the diminishing snowpack happens sooner due to an increase in atmospheric temperature. Snow in the Sierra is an extremely important water source, especially because it stores water that gradually melts and feeds streams and rivers all summer long. With earlier snowmelt, there is less water available later in the summer when it is needed the most. More data collected during future monitoring (and for more watersheds) will provide a stronger foundation upon which to identify a trend.

**References**

Swain, D.L., Langenbrunner, B., Neelin, J.D. and A. Hall. 2018. Increasing precipitation volatility in twenty-first-century California. Nature Clim Change 8,427–433.https://www.nature.com/articles/s41558-018-0140-y#citeas

*Recommendations*

- Acquire more data from LADWP for annual runoff. Would like to at least have 50-years of data.
- Get data for more gaged watersheds to help show a more solid trend, picking watersheds that are relatively undisturbed.
- For each watershed get more years of data, preferably going back 50 years.

# Theme 6: Fire Conditions

## CC03. How are fire regimes changing compared to the desired conditions and the natural range of variation?

The indicators for this question include: (1) fire return interval departure; (2) number and acres of wildfire by ecosystem type; and (3) fire severity by ecosystem type.

### *Relevant Plan Components*

FIRE-FW-DC-01: Wildland fires burn with a range of intensity, severity, and frequency that allows ecosystems to function in a healthy and sustainable manner. Wildland fire is a necessary process, integral to the sustainability of fire-adapted ecosystems.

TERR-MONT-DC-02: At the landscape scale, fire is a key ecological process restoring and maintaining patchy fuel loads, and increasing heterogeneity and understory plant vigor, except in Jeffery pine and dry mixed conifer forests (see desired conditions specific to those forest types). Fires occur irregularly, generally every 15 to 100 years, averaging about every 40 years. Fires in this zone burn with low, moderate, or mixed severity with minimal patches of high severity (greater than 75 percent basal area mortality) rarely greater than 300 acres in size. The proportion of areas burned at high severity within a fire is generally less than 10 to 15 percent.

**New Science or Other Information**

Most relevant new science is summarized in Safford and Stevens (2017), Meyer and North (2019), Meyer (2015), and Safford and Van de Water (2014).

### *Key Results*

#### Indicator 1. Fire Regime Interval Departure

Figure 1 and Table 16 display the mean fire return interval departure condition classes for the Inyo National Forest. Overall, contemporary fire regimes on the Inyo National Forest are burning too infrequently compared to historical (i.e., NRV) conditions, particularly the Sierra Nevada montane zone where 78% of the landscape is classified as moderately to highly departed from the lack of natural fires. In comparison, 53% of arid shrublands and woodlands and 43% of the subalpine and alpine landscapes are burning too infrequently. Very few areas in all three zones are burning too frequently compared to historical conditions (1-2% of each ecological zone). The subalpine and alpine zone is the least departed with about 57% of this zone within its natural fire return interval.

*Table 16. Fire Return Interval Departure (FRID) condition classes (CC) by ecological zone on the Inyo National Forest (2020 data). The 'too frequent' category includes both moderately and highly departed fire return interval departure categories (i.e., CC -2 and -3). The 'too infrequent' categories include vegetation types within each ecological zone where the current fire regimes are burning much less frequently than the historical fire regimes.*

| Ecological Zone and FRID Condition Class | Acres in Zone | Percent of Zone |
|---|---|---|
| ***Arid Shrublands and Woodlands*:** | | |
| Too frequent (CC -2, -3) | 10,963 | 1 |
| Not departed (CC 1, -1) | 471,425 | 46 |
| Too infrequent, moderate departure (CC 2) | 109,603 | 11 |
| Too infrequent, highly departed (CC 3) | 423,890 | 42 |
| ***Sierra Nevada Montane:*** | | |
| Too frequent (CC -2, -3) | 4,810 | 2 |
| Not departed (CC 1, -1) | 62,044 | 20 |
| Too infrequent, moderate departure (CC 2) | 44,423 | 14 |
| Too infrequent, highly departed (CC 3) | 196,583 | 64 |
| ***Subalpine and Alpine:*** | | |
| Too frequent (CC -2, -3) | 1,730 | 1 |
| Not departed (CC 1, -1) | 127,764 | 57 |
| Too infrequent, moderate departure (CC 2) | 24,046 | 11 |
| Too infrequent, highly departed (CC 3) | 72,398 | 32 |

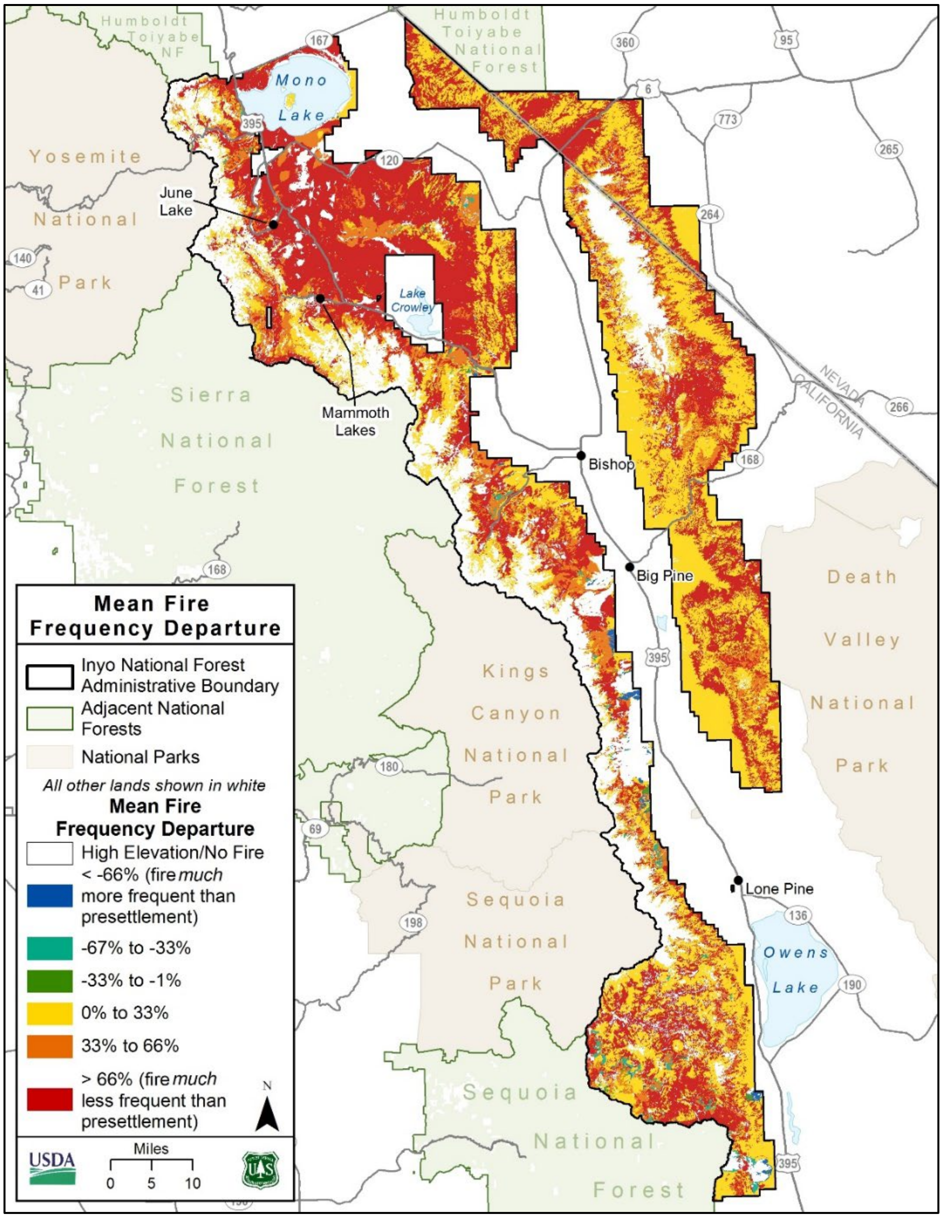



*Figure 36. Fire Regime Interval Departure (FRID) condition classes for the Inyo National Forest in 2020. Warmer colors indicate vegetation types where the current fire regimes are burning much less frequently than the historical fire regimes.*

## Indicator 2. Number and Acreage of Wildfires

The number and acreage of wildfires on the Inyo National Forest between 2017 and 2020 are presented in Table 17. The greatest number and acres of wildfires occurred in the Sierra Nevada montane zone (62% based on acres), followed by the arid shrublands and woodlands zone (33% based on acres). Only 5 percent of the burned area occurred in the subalpine and alpine zone. Ninety-eight percent of wildfires managed for multiple objectives occurred in the Sierra Nevada montane zone, whereas 52% of full suppression wildfires occurred in this zone. About 80% of the area burned in wildfires on the Inyo National Forest between 2017 and 2020 was managed with a full suppression strategy, whereas 20% of the burned area was managed with a multiple objective strategy. With respect to broad geographic patterns, all wildfires tended to occur within the Sierra Nevada portion of the Inyo National Forest, full suppression wildfires had a wide latitudinal range on the forest, and the two wildfires managed for multiple objectives were both located in the northern end of the forest along the eastern Sierra escarpment (2018 Lions Fire) and in the Glass Mountains (2019 Springs Fire).

*Table 17. Total number and acreage of wildfires by ecological zone on the Inyo National Forest (2017-2020). Wildfires are classified as managed under a full suppression strategy or multiple objective (e.g., suppression, resource objectives) strategy. Wildfires <10 acres in size are not included.*

| Fire Management Strategy and Ecological Zone | Number of Wildfires | Total Burned Area (acres) |
|---|---|---|
| ***Full Suppression**:* | | |
| Arid shrublands and woodlands | 8 | 13,932 |
| Sierra Nevada montane | 8 | 17,726 |
| Subalpine and alpine | 7 | 2,151 |
| Other (not evaluated) | 4 | 197 |
| Total number of full suppression fires | 16 | 34,006 |
| ***Multiple Objective:*** | | |
| Arid shrublands and woodlands | 1 | 14 |
| Sierra Nevada montane | 3 | 8,333 |
| Subalpine and alpine | 1 | 184 |
| Total number of multiple objective fires | 3 | 8,531 |

### Indicator 3. Fire Severity

Figure 36 displays fire severity proportions from full suppression and multiple objective wildfires in the Sierra Nevada montane zone on the Inyo National Forest (2017 and 2020). Wildfires managed under a full suppression strategy tended to have higher proportions of moderate and high severity fire and lower proportions of unchanged and low severity fire classes. In contrast, wildfires managed under multiple objective strategy (including resource objectives), tended to have higher proportions of unchanged and low severity fire classes and lower proportions of moderate and high severity fire. The two wildfires managed under multiple objectives (2018 Lions Fire, 2019 Springs Fire) shown in Figure 37 and Figure 38 displayed variable patterns of fire severity, with much higher fire severity effects evident in the 2018 Lions Fire than the 2019 Springs Fire. For example, the proportion of high severity fire in the 2018 Lions Fire was 27% (24% high severity based on composite burn index; 19% high severity based on the entire fire perimeter including areas on the neighboring Sierra National Forest), whereas only 1% of the Springs Fire burned at high severity (based on basal area loss and composite burn index). The maximum high severity patch size in the 2018 Lions Fire was approximately 242 acres but only 14 acres in the 2019 Springs Fire. Nearly the entire 2019 Springs Fire area (94% based on basal area loss and 89% based on the composite burn index) was classified in the unchanged and low severity classes.

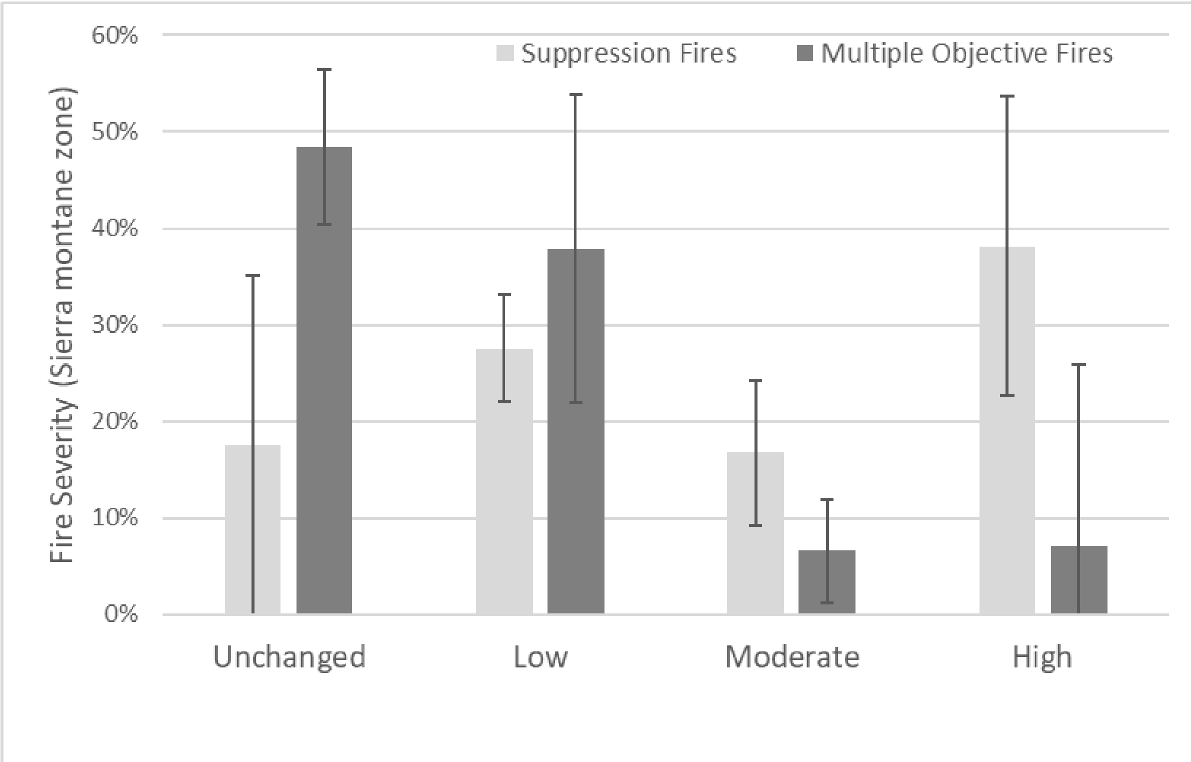



*Figure 37. Mean (± standard deviation) fire severity proportions in wildfires managed with a full suppression (4 fires) and multiple objective (2 fires) strategy in the montane zone, Inyo National Forest (2017-2020). Fire severity data is based on RAVG basal area loss categories: unchanged (0% basal area loss), low (1-25% loss), moderate (25-75% loss), and high (>75% loss).*

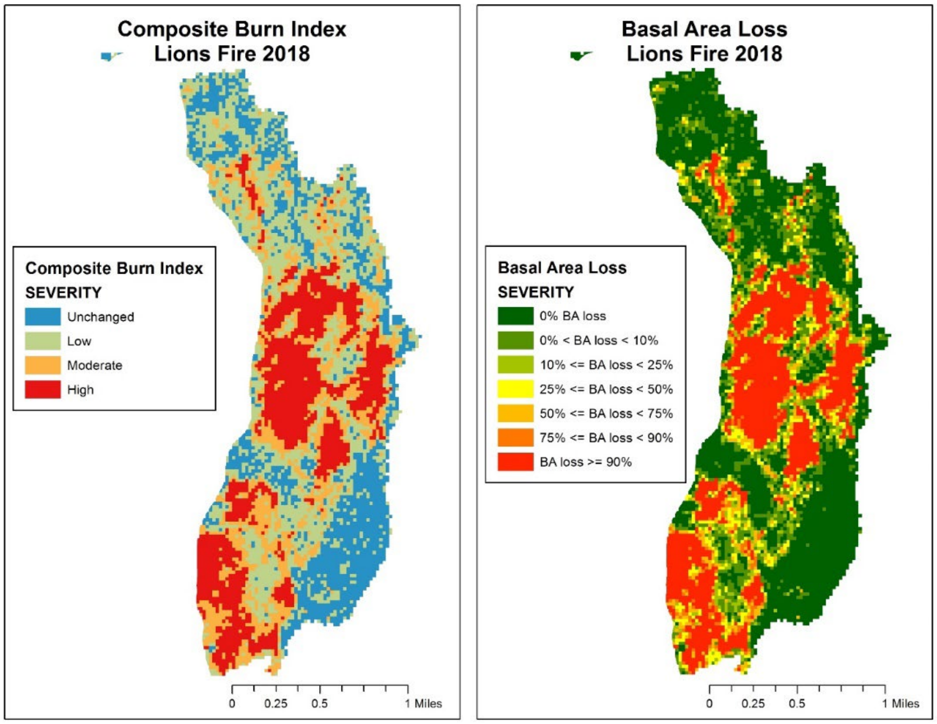



*Figure 38. Fire severity patterns derived from the composite burn index (left panel) and percent basal area loss (right panel) in the 2018 Lions Fire (managed for multiple objectives) on the Inyo National Forest (based on RAVG data).*

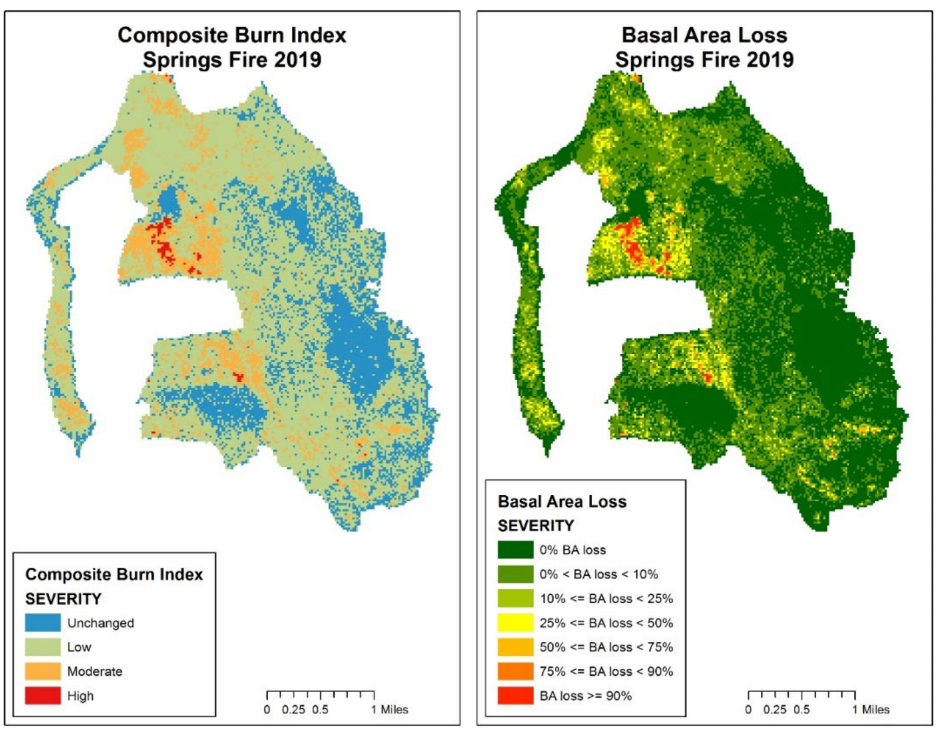



*Figure 39. Fire severity patterns derived from the composite burn index (left panel) and percent basal area loss (right panel) in the 2019 Springs Fire (managed for multiple objectives) on the Inyo National Forest (based on RAVG data).*

## Discussion

### Indicator 1. Fire Regime Interval Departure

Consistent with regional patterns observed by Safford and Van de Water (2014), fire return interval departure patterns on the Inyo National Forest in 2020 indicate widespread fire exclusion and moderate to high levels of fire return interval departure. This is particularly evident in the Sierra Nevada montane zone where 64% of the landscape is highly departed (i.e., FRID condition class 3) and dominated by frequent-fire forest types (e.g., Jeffrey pine and dry mixed conifer). The majority of the subalpine and alpine and arid shrublands and woodlands zones are not departed or only moderately departed from their historical fire frequencies. This suggests that the ecosystems in these zones are not exhibiting a substantial deficit in natural fire cycles, although long-term fire exclusion may have altered ecological conditions (e.g., increased biomass and fuels, conifer encroachment) in some ecosystem types in these zones such as pinyon-juniper woodlands. Across all three zones, very few areas (1% of the Inyo National Forest) are currently burning too frequently compared to historical fire regimes. However, with projected increases in fire frequency and seasonality associated with climate change (Chambers et al. 2017, Safford and Stevens 2017, Meyer and North 2019), future monitoring will be needed to evaluate whether these areas increase in size over time resulting in an upward trend in vegetated landscapes burning too often.

### Indicator 2. Number and Acreage of Wildfires

Virtually all of the area burned in wildfires managed under multiple objectives were located in the Sierra Nevada montane zone on the Inyo National Forest, which is consistent with ecosystem types (e.g., Jeffrey pine, dry mixed conifer) that are the most departed from their historical fire frequencies (see Fire Return Interval Departure section). This pattern is supportive of Inyo land management plan objectives for reestablishing natural fire regimes (e.g., TERR-FW-GOAL-02) and restoring ecosystem structure and composition (e.g., TERR-FW-GOAL-01), particularly for fire-dependent forest ecosystems (Safford and Stevens 2017, Meyer and North 2019). In contrast, wildfires managed under a full suppression strategy tended to occur in all three ecological zones, particularly in the lower elevation arid shrublands and woodlands and Sierra Nevada montane zones. Arid shrublands and woodlands may especially benefit from the use of full suppression strategies, since this zone is less departed from their historical fire frequency (see Fire Return Interval Departure section) and ecosystem types in this zone (e.g., sagebrush steppe, pinyon-juniper woodlands) may be negatively impacted by large wildfires that result in increased spread of nonnative invasive grasses, habitat fragmentation, and poor post-fire recruitment rates of native woody vegetation (Chambers et al. 2017).

### Indicator 3. Fire Severity

Fire severity patterns for full suppression wildfires in the Sierra Nevada montane zone are consistent with recent regional patterns, showing severe fire effects outside NRV, particularly in the yellow pine and mixed conifer forest types (Safford and Stevens 2017). In contrast, fire severity patterns in wildfires managed for multiple objectives are mostly consistent with Inyo forest plan desired conditions and NRV, as recently observed in the Southern Sierra ecoregion (Meyer 2015). In particular, the 2019 Springs Fire produced low severity fire effects that are fully consistent with the natural fire regimes of Jeffrey pine forests that dominate this area. In comparison, the 2018 Lions Fire on the Inyo National Forest produced more variable fire effects, with a high severity proportion (19-27%) exceeding NRV and desired conditions (≤15% of the burned landscape) and a maximum high severity patch size (242 acres) that may have exceeded these threshold values (200 to 300 acres). These results suggest that fire effects from the 2018 Lions Fire were mostly consistent with Inyo forest plan desired conditions and NRV, but some of the larger high severity burn patches in the central and southern parts of this fire on the Inyo National Forest may experience lasting negative ecological effects. These effects include the loss of forest resilience due to the failure of conifers to naturally regenerate, increased carbon emissions and reduced carbon carrying capacity, and the loss of habitat connectivity for forest-dependent species. Nevertheless, the 2018 Lions Fire likely played an essential role in reducing spread of the 380,000 acre Creek Fire (2020) towards to town of Mammoth Lakes as well as reducing the overall impacts of the Creek Fire on the Inyo National Forest. Future fire severity monitoring and research will help address this question and elucidate fire severity trends and potential long-term impacts to forest ecosystems resulting from full suppression and multiple objective wildfires on the Inyo National Forest.

### *Recommendations*

- Change “ecosystem type” to “ecological zone” for the second and third indicators (number and acreage of wildfires, fire severity).

**Literature Cited**


Chambers, J.C.; Beck, J.L.; Bradford, J.B.; Bybee, J.; Campbell, S.; Carlson, J.; Christiansen, T.J.; Clause, K.J.; Collins, G.; Crist, M.R.; Dinkins, J.B.; Doherty, K.E.; Edwards, F.; Espinosa, S.; Griffin, K.A.; Griffin, P.; Haas, J.R.; Hanser, S.E.; Havlina, D.W.; Henke, K.F.; Hennig, J.D.; Joyce, L.A.; Kilkenny, F.M.; Kulpa, S.M.; Kurth, L.L.; Maestas, J.D.; Manning, M.; Mayer, K.E.; Mealor, B.A.; McCarthy, C.; Pellant, M.; Perea, M.A.; Prentice, K.L.; Pyke, D.A.; Wiechman, L.A.; Wuenschel, A. 2017. Science framework for conservation and restoration of the sagebrush biome: Linking the Department of the Interior’s Integrated Rangeland Fire Management Strategy to long-term strategic conservation actions. Part 1. Science basis and applications. Gen. Tech. Rep. RMRS-GTR-360. Fort Collins, CO: U.S Department of Agriculture, Forest Service, Rocky Mountain Research Station. 213 p.

Meyer, M.D. 2015. Forest fire severity patterns of resource objective wildfires in the southern Sierra Nevada. Journal of Forestry 113(1):49-56.

Meyer, M.D.; North, M.P. 2019. Natural range of variation of red fir and subalpine forests in the Sierra Nevada bioregion. Gen Tech. Rep. PSW-GTR-263. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 135 p.

Safford, H.D.; and J.T. Stevens. 2017. Natural range of variation for yellow pine and mixed-conifer forests in the Sierra Nevada, southern Cascades, and Modoc and Inyo National Forests, California, USA. Gen. Tech. Rep. PSWGTR- 256. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 229 p.

Safford, H.D.; Van de Water, K.M. 2014. Using fire return interval departure (FRID) analysis to map spatial and temporal changes in fire frequency on national forest lands in California. Res. Pap. PSW-RP-266. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 59 pp.

## PC03. What management actions are contributing to the achievement of desired conditions relating to fire regimes?

The indicators for this question include (1) acres of fire within each fire management zone; (2) acres of prescribed fires – total and within each fire management zone; and (3) acres of thinning – total and within each management zone.

### *Relevant Inyo Plan Components*

One original Plan desired condition was related to this question: Reduce fuel accumulations, help maintain and protect habitat for a variety of species, reduce smoke from larger fires, provide added protection for communities, and restore fire on the landscape. These actions are also an integral part of achieving sustainable recreation, particularly by maintaining scenic attractiveness, integrity, and character.

That desired condition, while relevant to the question, is very general and contains many different types of desired conditions making it difficult to meaningfully evaluate. During the development of the monitoring guide, it was determined that additional plan components were more specific and easier to measure. The strategic fire management zone mapping considered all the desired conditions mentioned above, and the intention is to re-map those zones as conditions on the ground change.

Fire management zones will need to be evaluated and adjusted over time, and this monitoring question can be used to inform that process, while answering the question of whether our management activities are allowing the forest to have a more fire resilient landscape. The additional, more specific plan components that will be evaluated are:

MA-WRZ-GOAL 01: Create fire resilient landscapes that can be restored and maintained by managing wildfire to meet resource objectives, and prescribed fire and fuel reduction treatments.

MA-CWPZ-DC 02, MA-GWPZ-DC 02 and MA-WRZ-DC 03: Over time, risk is reduced sufficiently in the community wildfire protect, general wildfire protection, and wildfire restoration zones to allow some areas to be placed in a lower risk zone.

TERR-FW-OBJ 02: Restore low and moderate fire mosaics using prescribed fire on at least 20,000 acres within 10 to 15 years following plan approval.

### *Key Results*

Wildfire acres

- From 2015 to 2021, the Inyo NF has had a total of 60,445 acres of wildland fire, with 50,595 acres occurring under a full suppression strategy, and 9850 acres occurring under a strategy other than full suppression.
- Wildfires in 2018 and 2019 contributed to the total 9850 acres of wildland fire with a strategy other than full suppression, of which with 943 acres occurred in General Wildfire Protection, 7073 acres in Wildfire Restoration, 1834 acres in Wildfire Maintenance zones.

Prescribed Fire

- From 2015 to 2021, the Inyo NF has implemented a total of 3,636 acres of prescribed fire, predominately in the Wildfire Restoration Zone although not a result of LMP implementation.

- Prescribed fires in 2018 and 2019 contributed 77% of treated acres at 2,803 acres.
- More burning was desired however barriers to implementation during this time included limited weather windows, lack of staffing and qualified personnel, and a prolonged wildfire season. Notably, the dip in prescribed burning in 2020 and 2021 was primarily due to the Regional pause on Rx fire during the fire season despite available burning windows. When the pause was lifted, we were out of prescription for burning.
- In 2020 and 2021, the Inyo implemented prescribed burning on 362 acres towards the 20,000 acre objective (TERR-FW-OBJ 02).

Thinning:

- From 2015 to 2021, the Inyo NF implemented a total of 11,014 acres of thinning – the 7-year average was 911 acres.
- 2015 had the highest number of acres treated followed by a sharp decline, however the 2017 – 2020 period saw a recovery in the number of acres treated.
- Thinning has been focused in the Community Wildfire Protection zone where it is most impactful in reducing high fire severity risk.
- Wildfires in 2016, 2018, and 2019 contributed to fuel reduction activities in Wildfire Maintenance and Restoration zone.
- Despite not being able to have a service contract in 2020 due to the constraints of COVID 19, it had the second highest number of acres thinned.

*Table 18. Acres of wildfire and management actions implemented from 2015 through 2021, by fire management zone.*

| Type of Activity | Community Wildfire Protection (ac) | General Wildfire Protection (ac) | Wildfire Restoration (ac) | Wildfire Maintenance (ac) |
|---|---|---|---|---|
| **Wildfire** | 1485 | 20221 | 21181 | 17557 |
| **Prescribed Fire** | 333 | 1845 | 10000 | 2211 |
| **Thinning** | 3565 | 1273 | 388 | 181 |

*Table 19. Acres of wildlfire by strategic management zone, by year, from 2015 through 2021.*

| | Year | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| Acres of **Wildland Fire** by Strategic Fire Management Zone | Community Wildfire Protection | 132 | 1182 | 2 | 22 | 12 | 1 | 134 | 1485 |
| | General Wildfire Protection | 2633 | 4233 | 62 | 1731 | 4987 | 4482 | 2093 | 20221 |
| | Wildfire Restoration | 2114 | 2889 | 272 | 1052 | 10509 | 3022 | 1324 | 21181 |
| | Wildfire Maintenance | 1003 | 151 | 2444 | 1700 | 2372 | 9875 | 12 | 17557 |
| | Grand Total of Acres Per Year | 5882 | 8456 | 2779 | 4504 | 17880 | 17380 | 3563 | 60445 |
| Acres by Management Strategy per Year | Full Suppression | 5882 | 8456 | 2779 | 4504 | 9390 | 17380 | 3563 | 50595 |
| | Managed for Objectives other than Full Suppression | 0 | 0 | 0 | 1360 | 8490 | 0 | 0 | 9850 |

*Table 20. Acres of prescribed fire by strategic management zone, by year, from 2015 through 2021.*

| | Year | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| Acres of **Prescribed Fire** by Strategic Fire Management Zone | Community Wildfire Protection | 0 | 0 | 1 | 36 | 184 | 0 | 0 | 221 |
| | General Wildfire Protection | 0 | 0 | 81 | 148 | 42 | 1 | 0 | 272 |
| | Wildfire Restoration | 0 | 0 | 174 | 867 | 1149 | 361 | 0 | 2551 |
| | Wildfire Maintenance | 215 | 0 | 0 | 262 | 116 | 0 | 0 | 593 |
| | Grand Total of Acres Per Year | 215 | 0 | 257 | 1313 | 1490 | 362 | 0 | **3636** |

*Table 21. Acres of thinning on the Inyo National Forest, by strategic fire management zone, for each year from 2015-2021.*

| | Year | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| Acres of **Thinning** by Strategic Fire Management Zone | Community Wildfire Protection | 1654 | 232 | 402 | 972 | 1538 | 1474 | 745 | 7017 |
| | General Wildfire Protection | 651 | 392 | 359 | 94 | 126 | 422 | 410 | 2453 |
| | Wildfire Restoration | 344 | 366 | 164 | 17 | 71 | 119 | 164 | 1247 |
| | Wildfire Maintenance | 0 | 1 | 13 | 109 | 15 | 12 | 147 | 297 |
| | **Grand Total of Acres Per Year** | **2649** | **991** | **938** | **1191** | **1750** | **2028** | **1466** | **11014** |

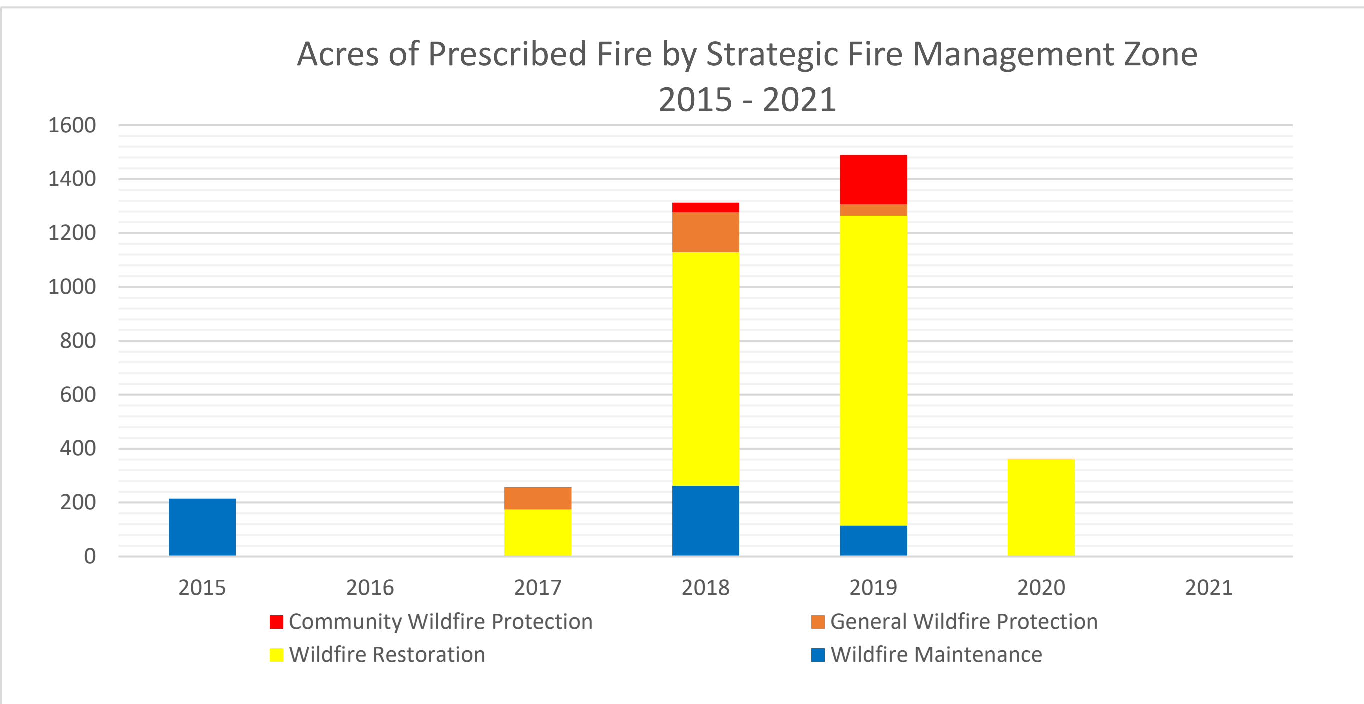



*Figure 40. Acres of prescribed fire on the Inyo National Forest from 2015-2021, by strategic fire management zone.*

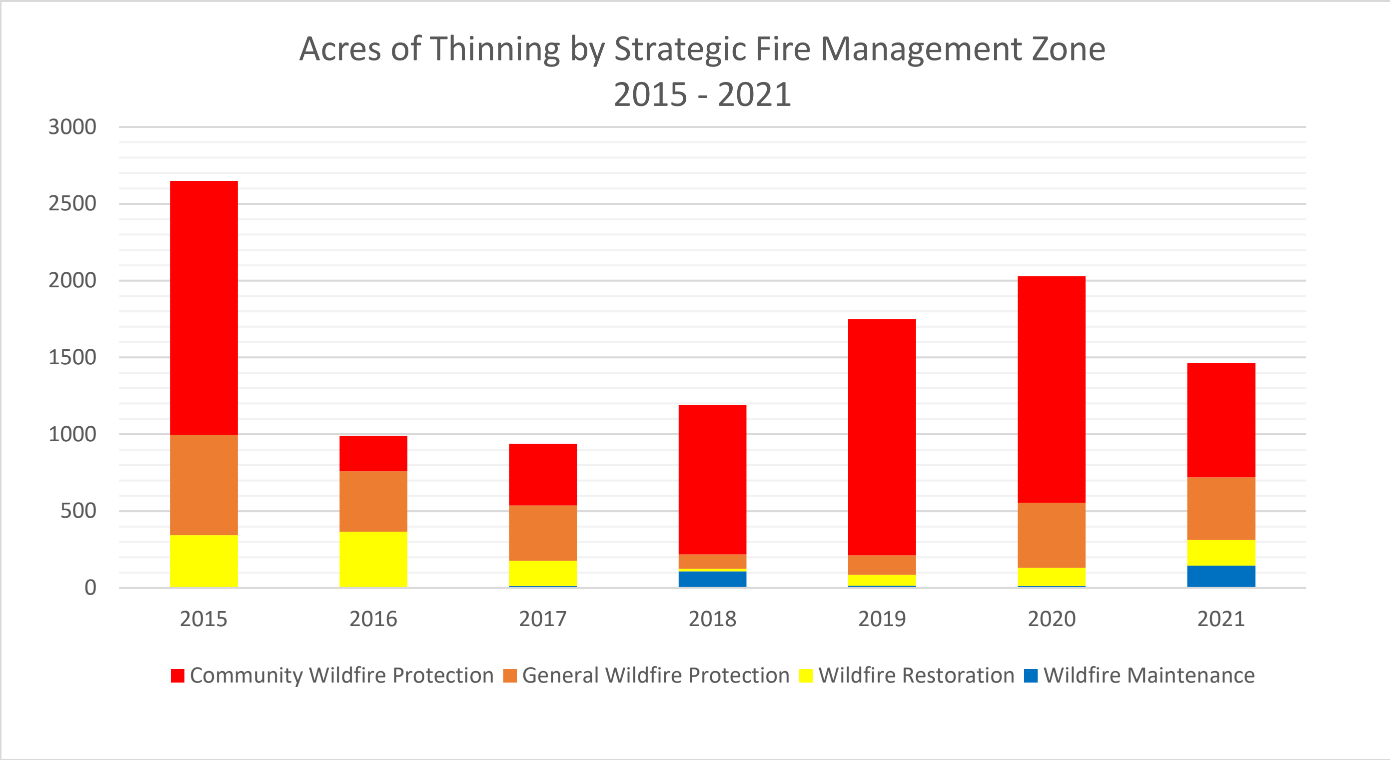



*Figure 41. Acres of tree thinning for fuel treatment by strategic fire management zone from 2015-2021, across the Inyo National Forest.*

### *Recommended Changes*

Based on these results, we are considering the following possible changes:

- Indicator 2 explicitly requests excluding pile burning which is commonly associated with prescribed fire. We excluded pile burning for this report but recommend changing the language to include pile burning and reporting it in all future reporting as pile burning can be a required step in the process of implementing an under burn or other prescribed fire activity. This relationship helps explain differences in prescribed fire implementation each year.
- Indicator 3 doesn't explicitly address all hand/mechanical fuel reduction activities (in addition to thinning) which are a substantial part of protecting communities and restoring wildfire as a process on the landscape. We included all activities in this report and recommend changing the language to say "all hand/mechanical fuel reduction activities" as opposed to just thinning.

# Theme 7: Social and Economic Sustainability

## PC01. What are the economic conditions in local communities that could affect the impact of national forest contributions to local economies?

Indicators associated with this monitoring question include: (1) economic health, (2) economic diversity, and (3) local fiscal conditions.

### *Relevant Plan Components*

Desired condition (LOC-FW-DC-03): National forest uses such as recreation, forest products, mining, and grazing are provided in an ecologically sustainable way that also contributes to economic and social sustainability in local communities.

### *Key Results*

Indicator 1. Economic health: unemployment rate, average earnings and per capita income

Data for economic health was downloaded from Headwater Economics - Economic Profile System Summary Report. It was separated by the 4 most directly affected counties: Mono and Inyo Counties in California, and Esmeralda and Mineral Counites in Nevada. ***Note: The data was only available through 2019***

**California Counties:**

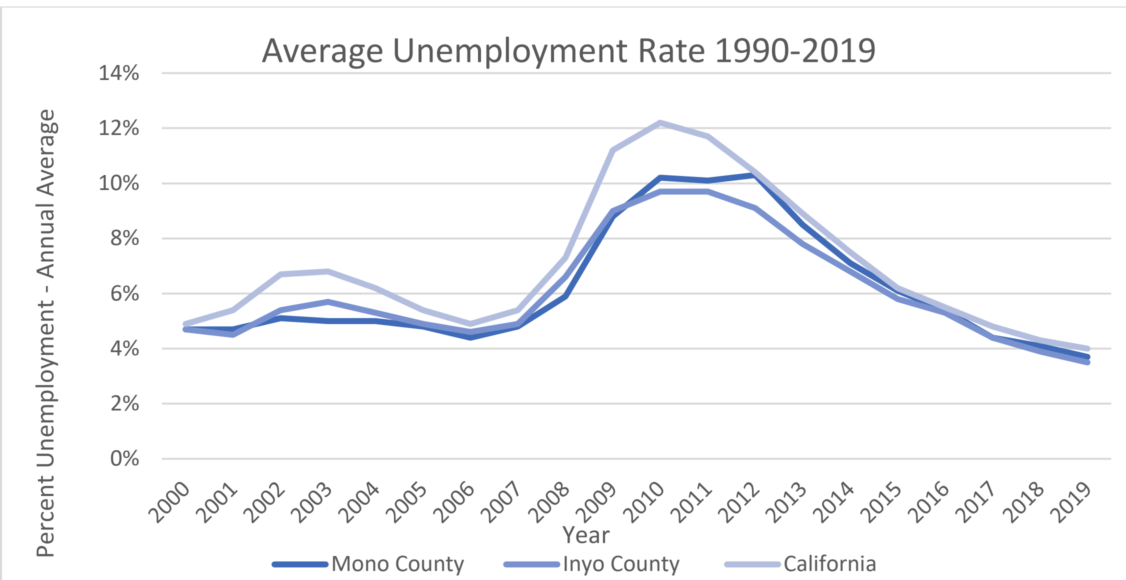



*Figure 42. Percent unemployment in Inyo and Mono Counties, California, from 2000-2019*

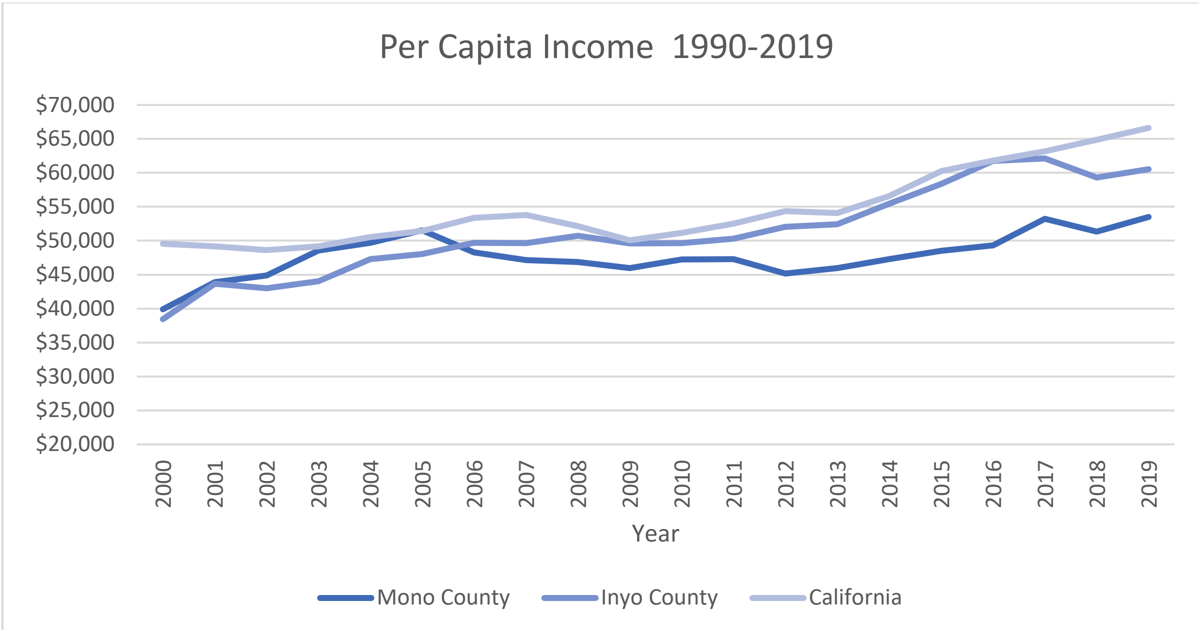



*Figure 43. Per capita income in Inyo and Mono Counties, California, from 2000-2019.*

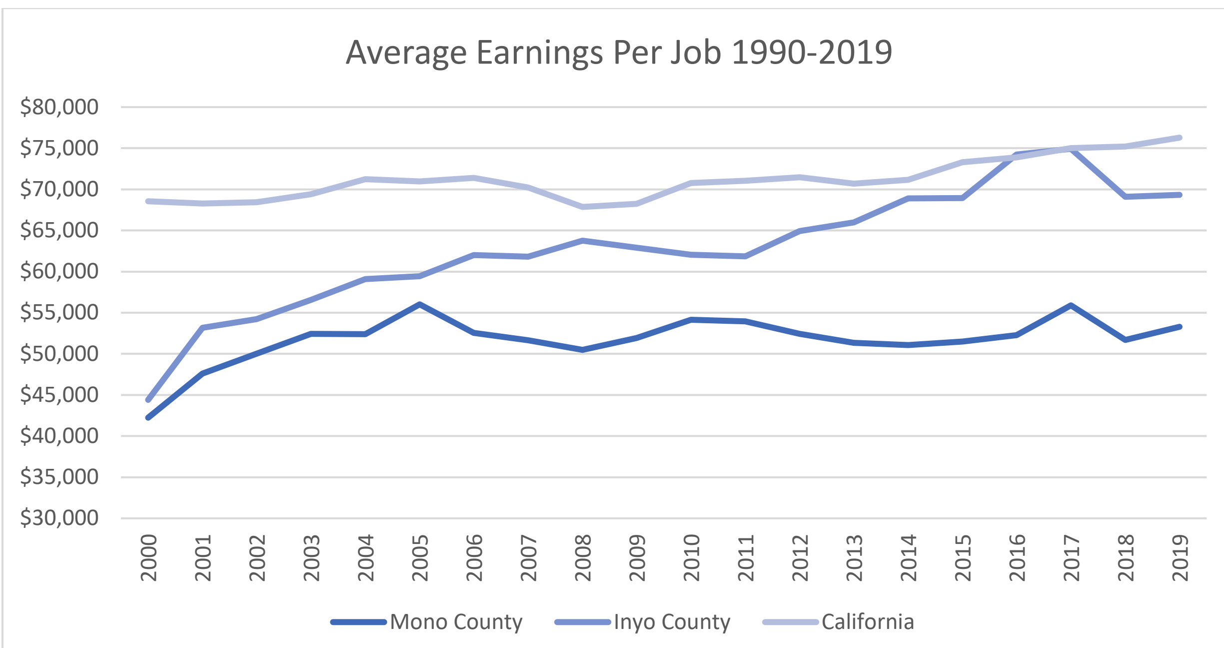



*Figure 44. Average earnings per job in Inyo and Mono Counties, California, from 2000-2019.*

**Nevada Counties:**

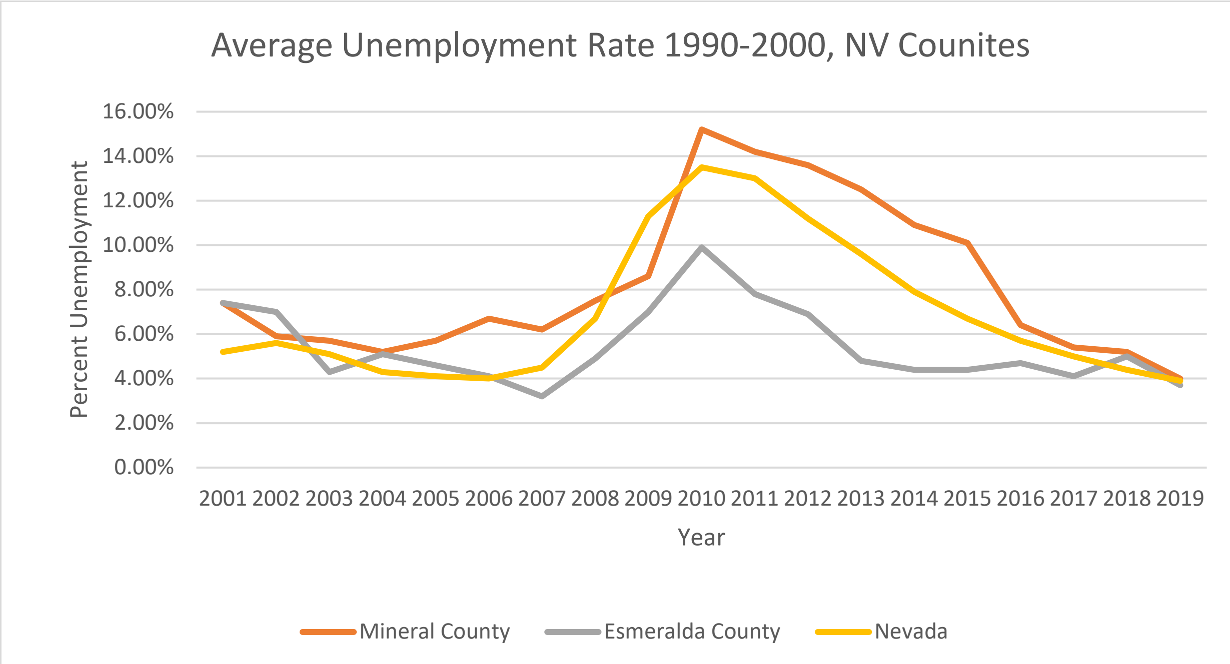



*Figure 45. Average unemployment rate in Mineral and Esmeralda Counties, Nevdada, from 2000-2019*

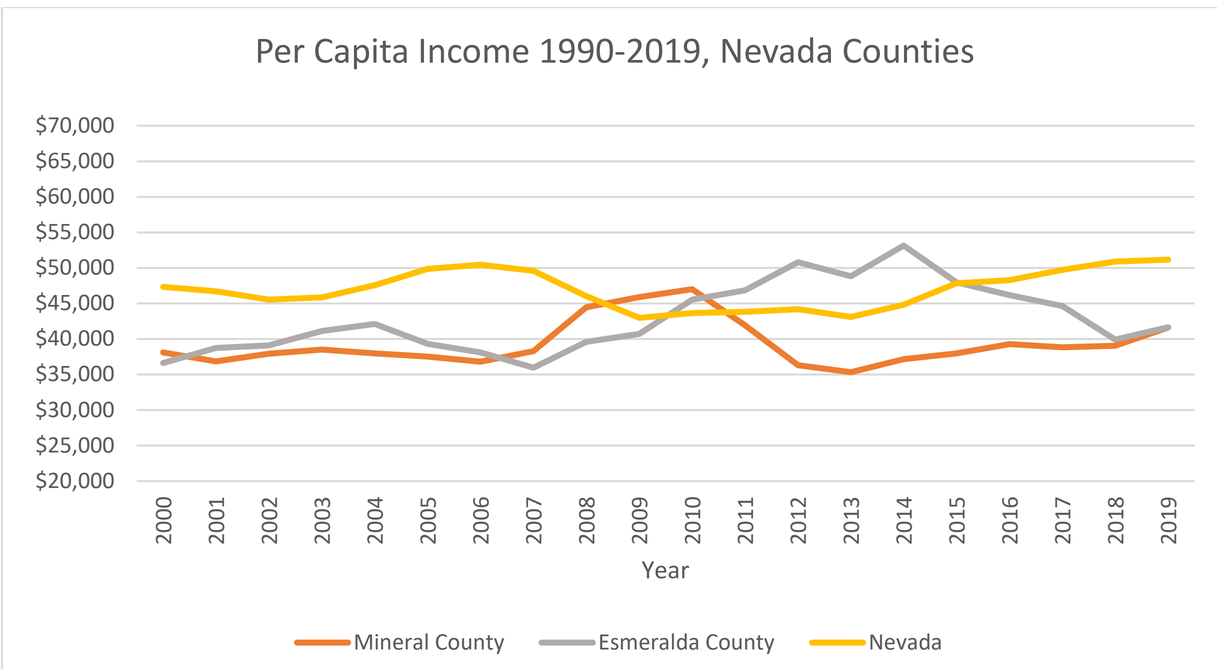



*Figure 46. Per capita income in MIneral and Esmeralda Counties, Nevada, from 2000-2019.*

General trends in unemployment, average earnings, and per capita income from 2000-2019 suggest that economic health is trending slightly positively in Inyo and Mono counties, California, and remaining relatively unchanged in Mineral and Esmeralda counties, Nevada, despite annual fluctuations. However, Mineral county experienced a slight decline in average earnings during this period ($47,000 in 2000 to $39,000 in 2019). All four counties experienced a major peak in unemployment around 2010 and 2011 (with some lingering longer) but ended in 2019 with 4% unemployment, a lower rate than in 2000.

Indicator 2. Forest based economic sectors: total employment and percentage of total private employment in recreation and tourism-based services. Data for forest based economic sectors was downloaded from Headwater Economics -Economic Profile System Tourism Report. ***Note: The data was only available through 2019.***

**California Counties:**

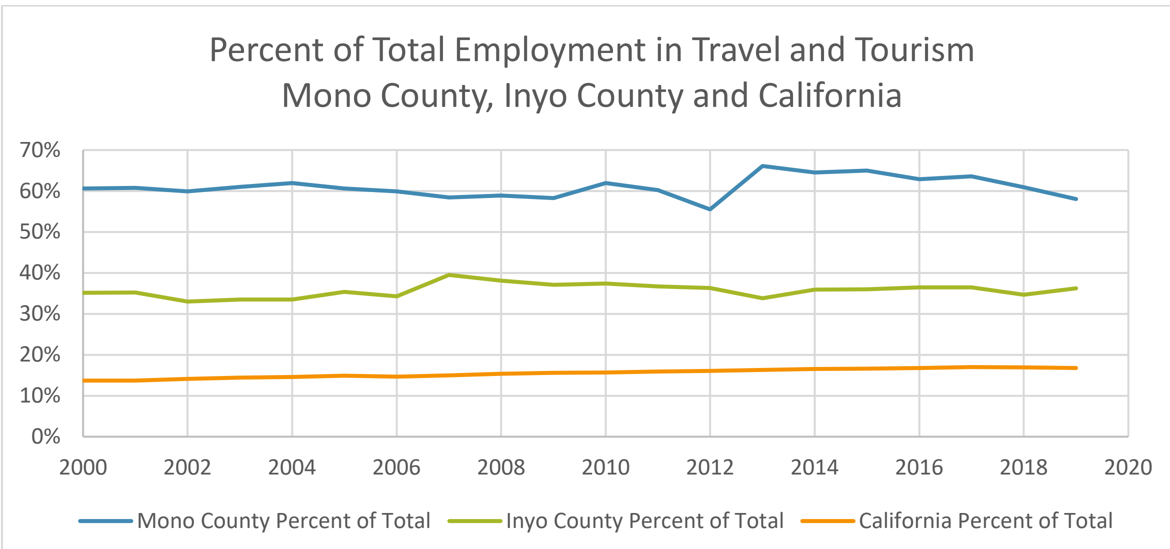



*Figure 47. Percent of total employment in travel and tourism in Mono and Inyo Counties, California.*

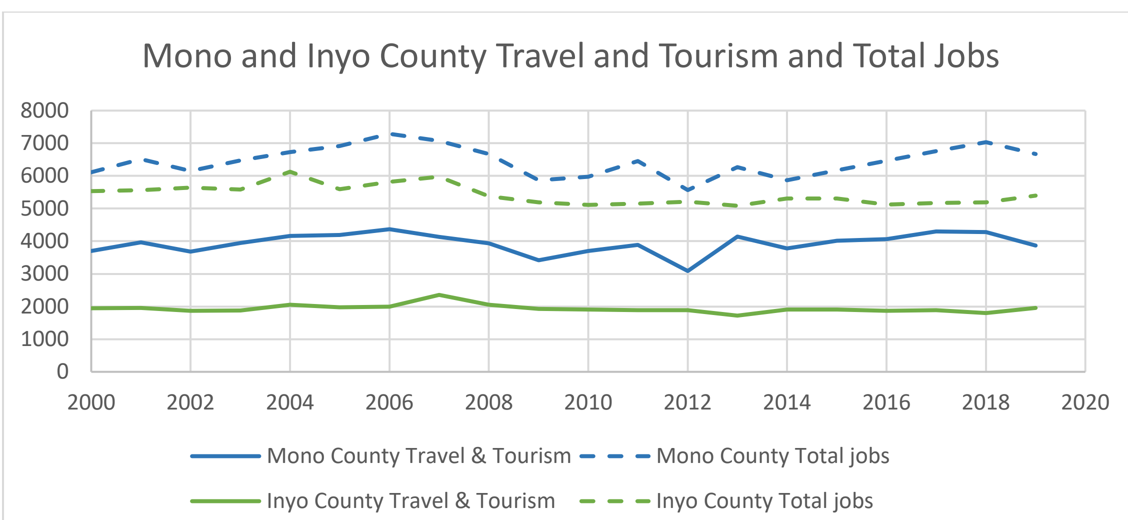



*Figure 48. Total jobs in the travel and tourism sector in Mono and Inyo Counties, California.*

**Nevada Counties:**

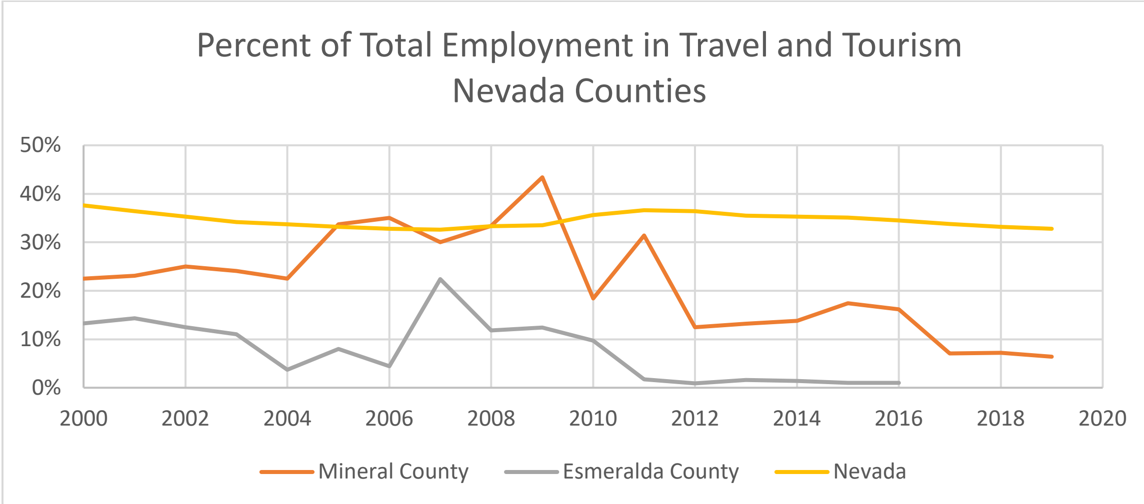



*Figure 49. Percent of total employment in travel and tourism in Mineral and Esmeralda Counties, Nevada*

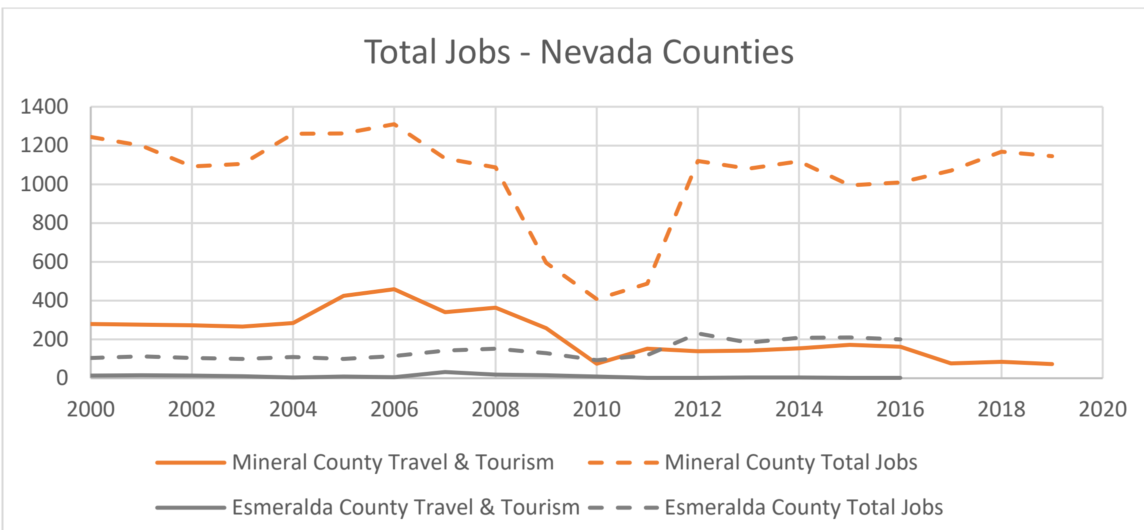



*Figure 50. Total jobs in travel and tourism in Mineral and Esmeralda Counties, Nevada, compared to total jobs.*

Employment in travel and tourism remained relatively stable in the two California counties but declined sharply in the two Nevada counties between 2010 and 2019 (to less than 10% of total jobs). The travel and tourism industry is the largest job sector related to Inyo National Forest management in the California counties, making up over half the jobs in Mono county and about 40% in Inyo county. Mono County has, by far, the highest percent of jobs in tourism industries, with about 60% of jobs related to tourism. The Town of Mammoth Lakes is the largest town in Mono County, and the Mammoth Mountain Ski Area, which is partially on the Inyo NF, is a large draw for out-of-town visitors. Its economy is based on tourism, mainly related to outdoor recreation, so the National Forest is a big part of the economic base of Mono County. Inyo County is also highly dependent on tourism, but less than 40% of jobs are tourism related.

These trends are important to continue monitoring, not the actual # of employment necessarily, but the relative proportion of total changes in the local economy where data are available, especially during an economic downturn / pandemic. We will continue to evaluate where trends might indicate that the Inyo National Forest output/visitation remain constant but the surrounding counties are undergoing drastic changes during the same period. Under this scenario, the importance of Inyo program delivery will by default, change and this will be important because the public and users' perception and expectation of the Forest shifts and the Forest will need to evaluate how/if to adapt.

Trends in Inyo county travel/tourism jobs appear to have remained relatively stable from 2000-2019. Mono county trends showed a slight dip in 2012 and an overall very minor increase (fewer than 200 job increase) from 2000 to 2019 (Figure 1). In Nevada, travel/tourism jobs comprise a smaller proportion of the overall job market, making up less than 30% of the total jobs, and travel/tourism jobs in the Nevada counties declined between 2010 and 2019 such that Mineral and Esmeralda counties have fewer than 100 and 50 travel/tourism jobs, respectively.

The Inyo National Forest plays a large role in supporting the local travel and tourism industry (and local fiscal conditions) with a wealth of natural settings to enjoy and attractions like Mammoth Lakes ski resort. The 2016 National Visitor Use Monitoring (NVUM) Report found that 83% of visitors interviewed responded that recreation was the purpose of their visit to the Inyo National Forest. According to this 2016 report, the average total trip spending for each party visiting the National Forest is $1,361 (median $800) and nearly 80% of visits involved an overnight stay, with about 45% of stays renting a private home.

<u>3. Indicators added for this first monitoring period</u>

The protocol included only travel and tourism jobs to look at Forest contributions, because recreation/travel and tourism are the overwhelming use of the forest in terms of direct economic impact. However, the desired conditions address recreation, forest products, mining, and grazing, and the monitoring originally focused only on recreation (measured as tourism/travel). Though forest products, mining and grazing are currently very small segments of the local economy, management of the Inyo National Forest has the potential to affect them also. Therefore, we will add jobs related to these sectors, which we have added below

- Jobs in the **Forest Products** Sectors

We looked up data for timber/forest products related jobs in the 4 affected counties, and they showed **no timber-related jobs**. We know that there are timber-related jobs in Mono County, but none are showing up past 2012. We will continue to search for this data in case there are changes in the future. With increased pace and scale of thinning, it is possible that these jobs could increase in the future. Many thinning contractors come from out of the area, and therefore may not show up as jobs in the local counties. However, there would be some indirect beneficial economic effects because their workers stay in lodging and purchase food and other necessities while in the area.

- Jobs in the oil, gas and mining sector

**California Counties:**

For mining, Headwaters Economics did not show any jobs in Inyo County since 2016, when it showed 96 mining jobs. That was down from a peak of 215 mining-related jobs in 2013. The lack of any mining jobs may be related to their privacy policy, where they do not share data when there are only a few operators in the County. There were mining jobs shown in Mono County in California, and the two Nevada Counties, as displayed in the graphs below:

According to Headwaters Economics, geothermal energy production and exploration is not included in the mining, oil and gas sector, or any other sector recorded by Headwater Economics. According to an Ormat representative, in October of 2021, the geothermal plant near Mammoth Lakes (Mono County) employed 22 full-time employees. New construction is also occurring in October of 2021, which was approved through a decision in 2013, involving and average of 85 employees. This new construction involves drilling geothermal production wells and an additional power plant. We will continue to monitor geothermal-related job trends as part of this section.

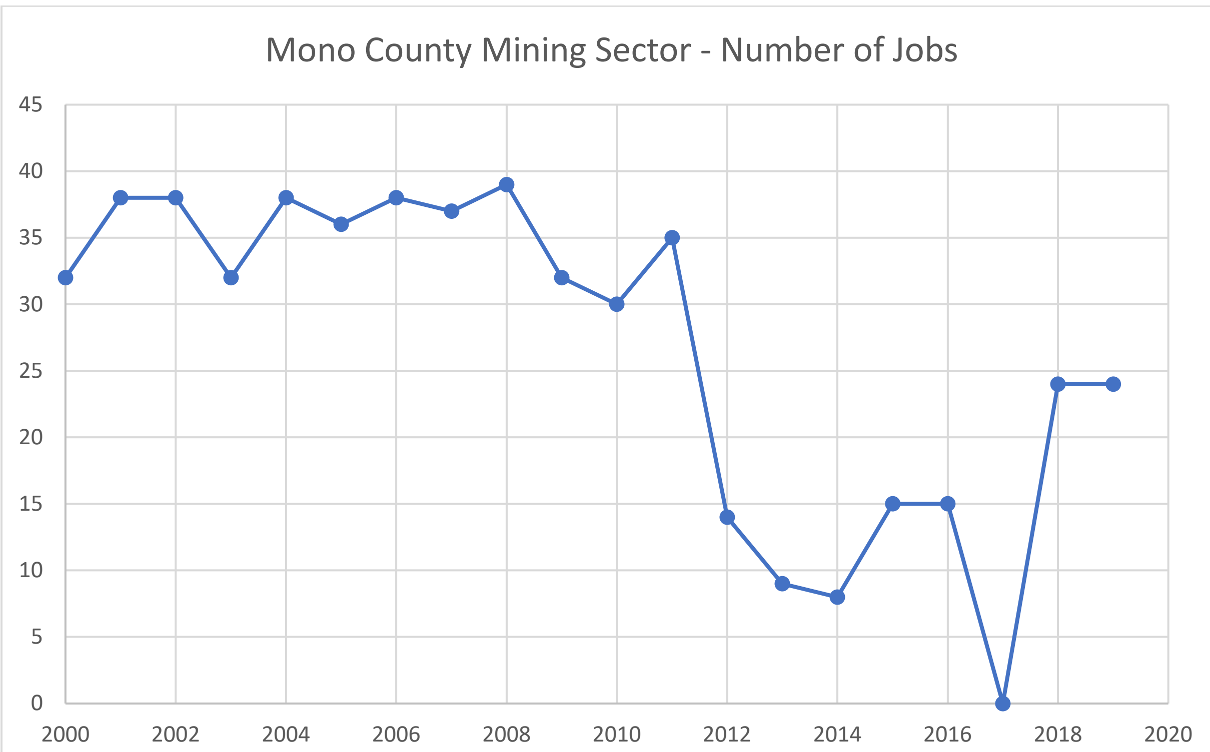



*Figure 51. Number of jobs in the Mining Sector in Mono County, California.*

*Note: The percentage of total jobs in the mining, gas and oil sectors in Mono County is not shown because it is so small that it is insignificant. In all years, it is less than 1% of the total jobs.*

**Nevada Counties:**

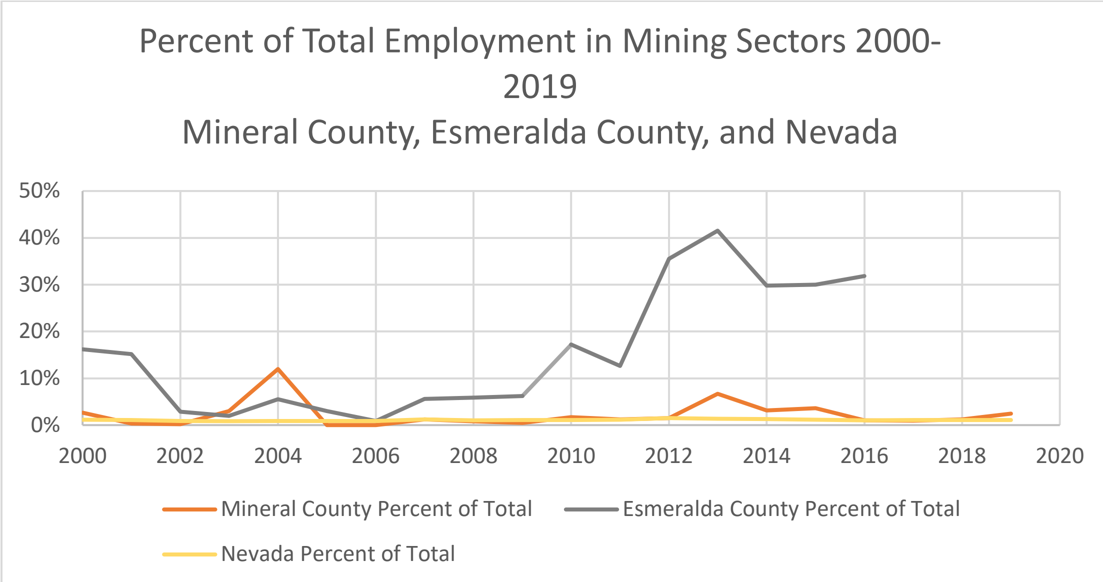



*Figure 52. Percent of total employment in mining sectors from 2000-2019 in Mineral and Esmeralda Counties, Nevada.*

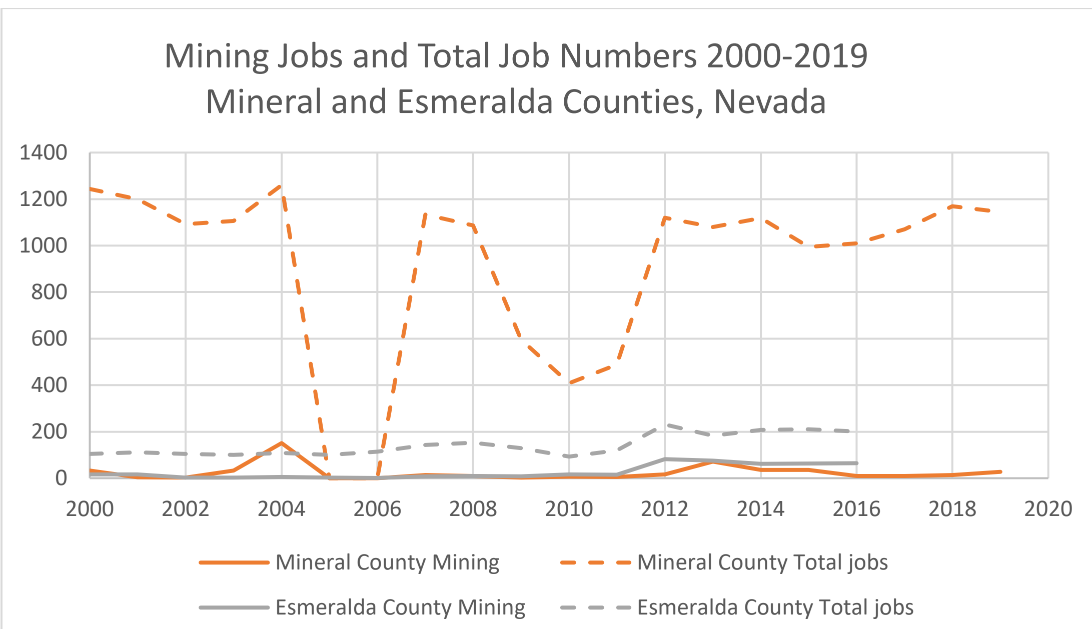



*Figure 53. Number of jobs in the mining sector compared to total jobs in Mineral and Esmeralda Counties, Nevada.*

Mining has provided a very small portion of the jobs in Mono County, and though the number has varied from 40 to 25 jobs, the overall influence is still very small.

In the Nevada Counties, particularly Esmeralda County, mining plays a relatively larger role in employemnt. In 2014, over 40% of all jobs in that County were in the mining, oil and gas sectors. The numbers of jobs in the mining-related industries has fluctuated over time, and there is no data for

Esmeralda county after 2016 for mining or total jobs. Therefore, we can make no evaluation of the trends for mining jobs.

Again, this information will be used as a baseline and to track trends. It can be compared to information about mining approvals on the Forest to see if there is a correlation. Mines may not be on Forest land, and Esmeralda and Mineral Counties have a small proportion of land on the Inyo National Forest. Therefore, mining activity is not necessarily related at all to Forest management.

- Jobs in the Grazing Sector

We do not have data for jobs in the livestock grazing sector, but do have data for agriculture, which includes all forms of agricultural production, including livestock operations.

We did not display this information for Esmeralda and Mineral Counties in Nevada because while livestock grazing is a relatively major use in these Counties, the percent on the Inyo National Forest which is grazed is so small as to likely provide almost no economic benefit in these Counties.

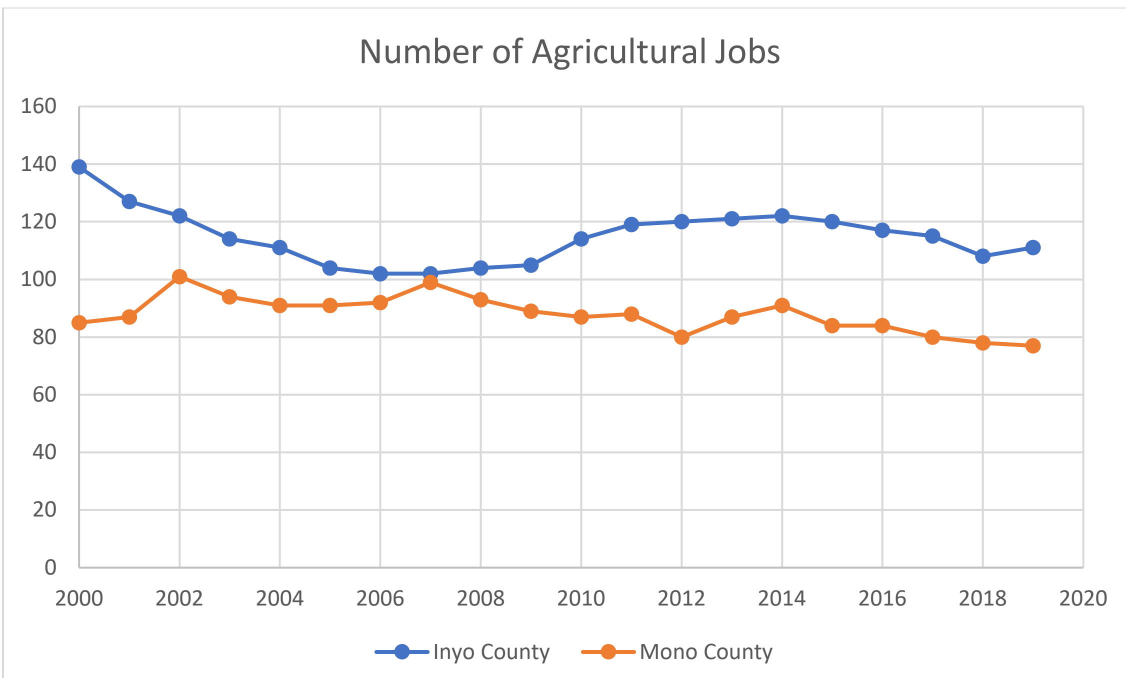



*Figure 54. Number of jobs in the agriculture sector in Inyo and Mono Counties, California, from 2000-2019.*

Agriculture provides less than 1% of the jobs in Inyo and Mono Counties. There was a slight downward trend in the agricultural sector in Inyo County over the past 20 years, and a very slight downward trend in Mono County. While this covers all agricultural sectors, Headwaters Economics reports that about 85% of the agricultural sector in Inyo and Mono Counties are from livestock, versus crop farming.

- Jobs in the Government Sector

For this indicator, we combined Inyo and Mono Counties, since the jobs on the Inyo National Forest are split roughly evenly between the two Counties. There are no Inyo National Forest jobs in the Nevada Counties.

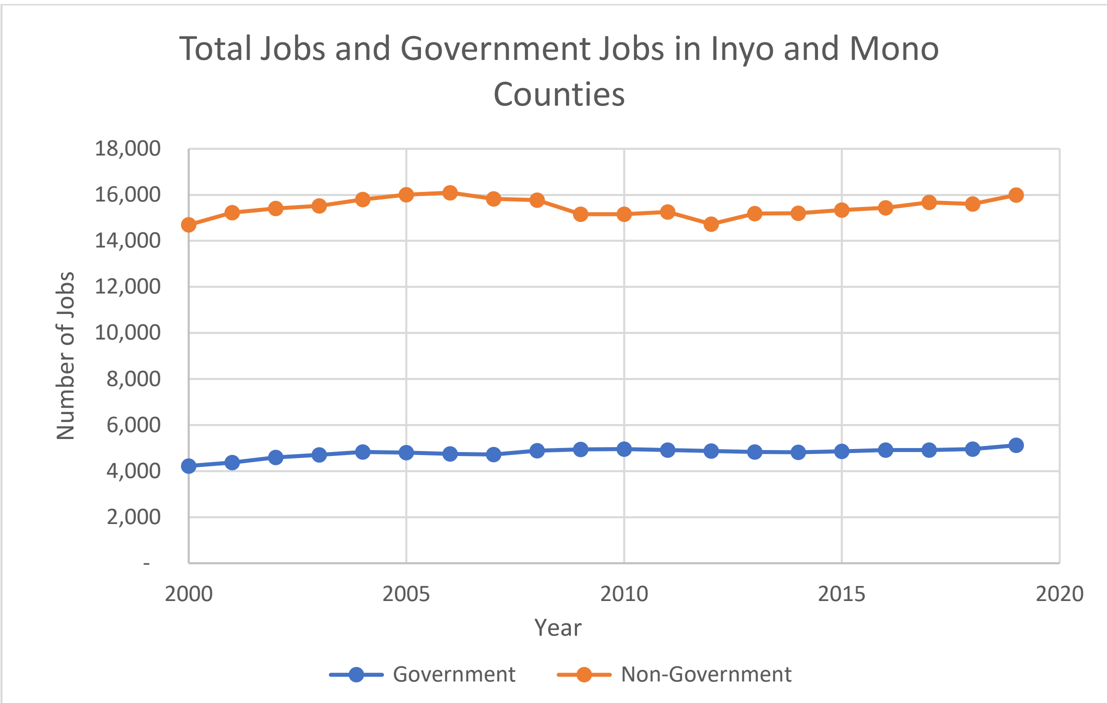



*Figure 55. Total jobs and government jobs in Inyo and Mono Counties, combined. The Government jobs in this chart include federal, military, state and local*

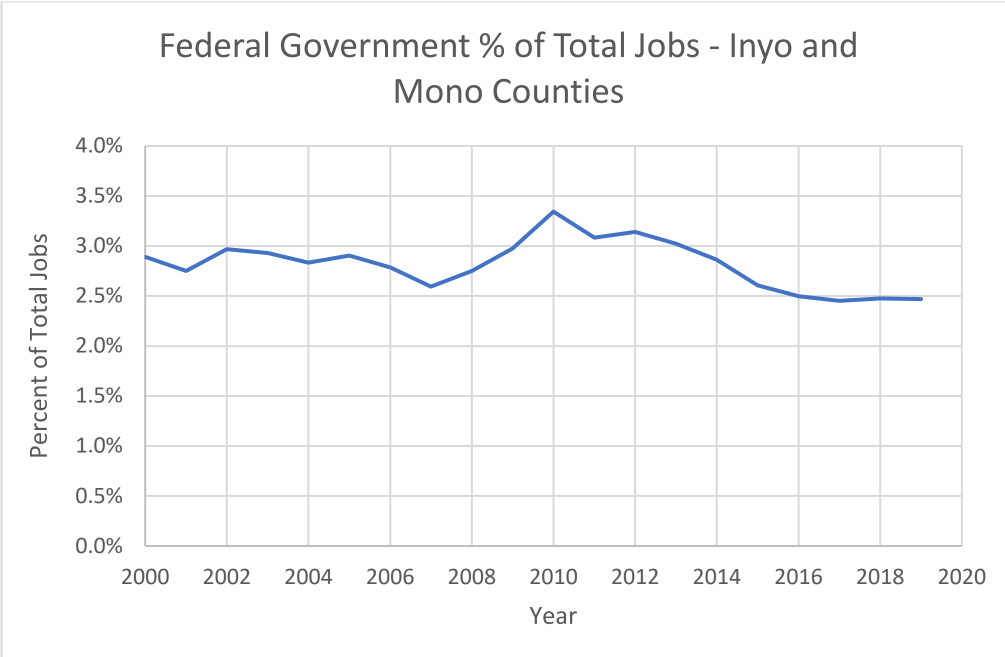



*Figure 56. The percent of total jobs in Inyo and Mono Counties that are in the Federal Government.*

The chart above shows that the percent of total jobs that are with the Federal Government ranged from below 2.5% to almost 3.5% over the past 20 years. The general trend, while variable, is slightly downward over that time. The peak in 2010 is partially due to the fact that the recession led to fewer total jobs in these Counties, while federal government jobs were not reduced. In addition, the number of government jobs did actually slightly increase during that time, likely as a result of stimulus money that went to Federal agencies during the recession.

### *Recommendations*

See PC02.

## PC02. What economic contributions are national forest-based recreation, forest products, mining and grazing making to local communities?

Indicators associated with this monitoring question include conditions in forest-based sectors and Forest contributions.

### *Relevant Plan Components*

Desired Condition (LOC-FW-DC-03): National forest uses such as recreation, forest products, mining, and grazing are provided in an ecologically sustainable way that also contributes to economic and social sustainability in local communities.

### *Methods*

Since the development of the monitoring guide, we identified new data sources for our indicators that represent the best available scientific information. These Forest use and resource metrics listed below are those currently identified to contribute to the economy surrounding the Inyo National Forest, as they support and sustain local business activities. Other uses and resource metrics such as water supply, energy such as hydroelectric generation or geothermal production, can be evaluated in the future if the use becomes a greater portion of the local economy or data become available.

- Recreation:
  - Metric: Total annual Forests visits, trip spending
  - Data source: Natural Resource Manager National Visitor Use Monitoring (NVUM).
- Forest timber products:
  - Metric: forest product volume sold by various categories
  - Data source: NRM Timber Information Manager (TIM) database. Various Forest Products Reports are available from the TIM database information, including the Periodic Timber Sale Accomplishment Reports (PTSAR) and the Forest Products Cut and Sold Report. The PTSAR report provides quarterly updates for forest product volume sold by various categories, including the regular program funded with appropriations, the Salvage Sale Fund, personal use permits and small commercial sales. Data can be used to evaluate the amount of wood cut and sold for personal and commercial uses, including the volume that went to processing facilities. Cut and Sold reports show total volumes and values of all convertible forest products sold and harvested from the National Forest System lands and National Grasslands agency-wide, and by organizational unit. Data from the two reports should be evaluated to identify the trend in forest products that have contributed to local economic conditions. Data may be used to estimate the number of full-time employees (FTE) supported by the products (Lippke and Mason 2005) but should only be calculated for products sold through contracts and agreements and not data for personal fuelwood permits.
- Rangeland Management economic conditions:
  - Metric: grazing volumes
  - Data source: NRM Rangeland Management
- Mining (mineral materials and locatable minerals)
  - Metric: Number of active mines on the Inyo National Forest.

    - Data source: NRM Minerals
- Forest employment and labor income in local communities. Forest employment can be obtained through a HRM Custom Reports request. Can be requested using the instructions the website: http://fsweb.wo.fs.fed.us/hrm/data-reports/index.php). If partnership and volunteer agreements become more common in the future and foster a meaningful number of local jobs, they may be included in future reports.

Data were, and should continue to be, examined to determine if there are discernable and meaningful changes in the identified values, suggesting a potential change in forest- generated economic contributions to communities. Given the importance of recreation to local economies around the Sierra and Sequoia National Forests, for example, this would be done by looking at trends in the estimates of visitation and spending. The best measure of community conditions and trends would be data collected at a community level; however, community level data are often difficult to obtain, therefore more aggregated data may be the best available (e.g., county, regional, state level data). That being said, caution should be used in applying aggregated data, such as county level data, to represent forest community conditions and the resulting

Sustained negative trends in these values could suggest changes in local conditions that may be related to Forest Service management actions. Depending on the outcome, there may or may not be actions the Forest can take to address these trends. It is important to remember that economic data is driven by many different external factors so one should not immediately associate any measurable economic effects to forest management. Instead, for further clarity, these data should be used as a basis for conversations with local community stakeholders and county governments to better understand what may be driving any changes. Contacting local stakeholders to review these trends will help build relationships to ensure a common understanding and interpretation of the results.

### *Key Results*

**Recreation – Not being reported this year.**

The NVUM was last completed in 2016, and since that was over 5 years ago, we are not going to use that data for this report. The NVUM is completed every 5 years and should be out in 2022. We will use those results for the next monitoring report.

**Forest Timber Products**

We used the measured of "volume of wood sold" in hundred cubic feet (CCF) for the measure of timber product volume. These data were obtained from the NRM Timber Information Management (TIM) database. The database includes public fuelwood, timber sales, and other forest products. Unlike some other data, these data are reported by fiscal year (October 1-Sept. 30), which must be considered when interpreting or comparing the data.

As shown in the chart below, there is no major trend in volume of wood sold over the past 10 years. There were peaks in 2011 and 2012, but since then, there has been a pretty steady output of around 4,000 CCF. There may be a slight downward trend from 2010 to the present, with annual variation.

We cannot compare this with timber-related jobs since we do not have timber job data in any County. We will continue to track jobs data to see if there is an increase over time with the increase in pace and scale of fuels removal as a goal in the Land Management Plan.

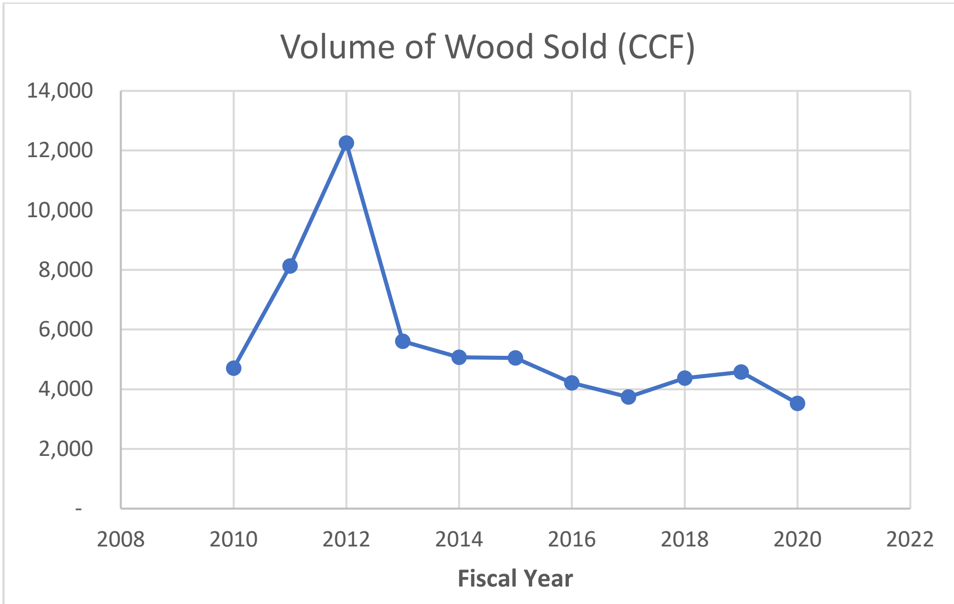
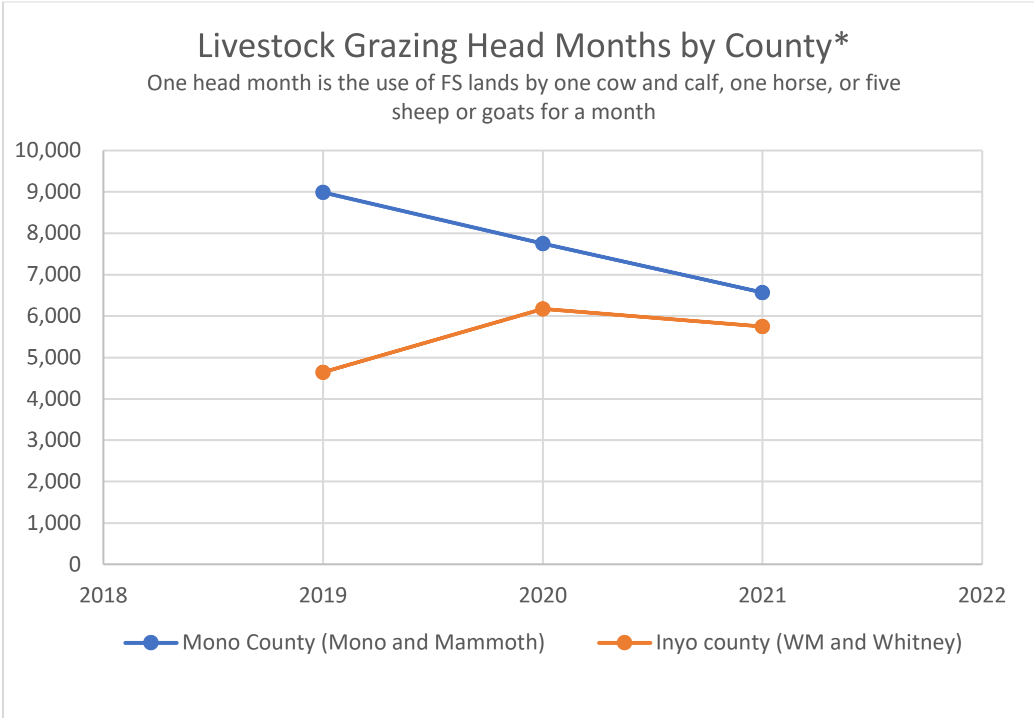



*Figure 57. Volume of wood sold off of the Inyo National Forest from 2008-2022, in hundreds of cubic feet (ccf)*

**Rangeland Management economic conditions**

Livestock grazing is another Forest use that supports relatively few jobs in any county within the influence of the Inyo National Forest. Despite the small contribution, we will continue to track grazing to view trends in this culturally important sector.




We obtained the animal unit months for the past 3 years, from 2019 through 2021. This is one of the few economic metrics with data available through 2021. We generally separated allotments by County, though grazing is reported by allotment, not County. Some allotments cross between Inyo and Mono County in California, and some allotments are split between Tulare County and partially in Inyo County. Some allotments also cross into the Nevada Counties. We split the allotments by Mono County and Inyo County, assuming that most access and therefore jobs were through those Counties, and because it is difficult to split it up. Allotments on the Mono Lake and Mammoth Ranger Districts were considered to be most influential to Mono County. Allotments in the White Mountain and Mount Whitney Ranger Districts were considered most influential to Inyo County. Many of the livestock producers are not based in any County within the influence of the Inyo National Forest, and therefore the economic benefit cannot be directly attributed to any one County from any one allotment. We will continue to refine these measures and how to split them up if we obtain more information in the future.

As can be seen in the chart above, there has generally been a decreasing trend in animal unit months used in Mono County, and an increase in Inyo County. Because the data is for three years only, no conclusions about long-term trends can be made. We will continue to display this data in future reports, with additional years to develop a possible trend.

**Mining (mineral materials and locatable minerals)**

There are no large active mines on the National Forest in any of the four Counties. There are many old mines, and some proposed exploration projects. There is also one cinder mine, at Black Point, that remains active but employs only a few people. Mining jobs in these Counties are therefore almost entirely on non-Forest land and unaffected by any Inyo National Forest management.

**Forest employment**

The most direct benefit of the Inyo National Forest to local communities is from Forest employment. Figure 3 shows the total employment on the Inyo National Forest over the past 11 years. All of the jobs on the Inyo National Forest are in Inyo and Mono Counties, California.

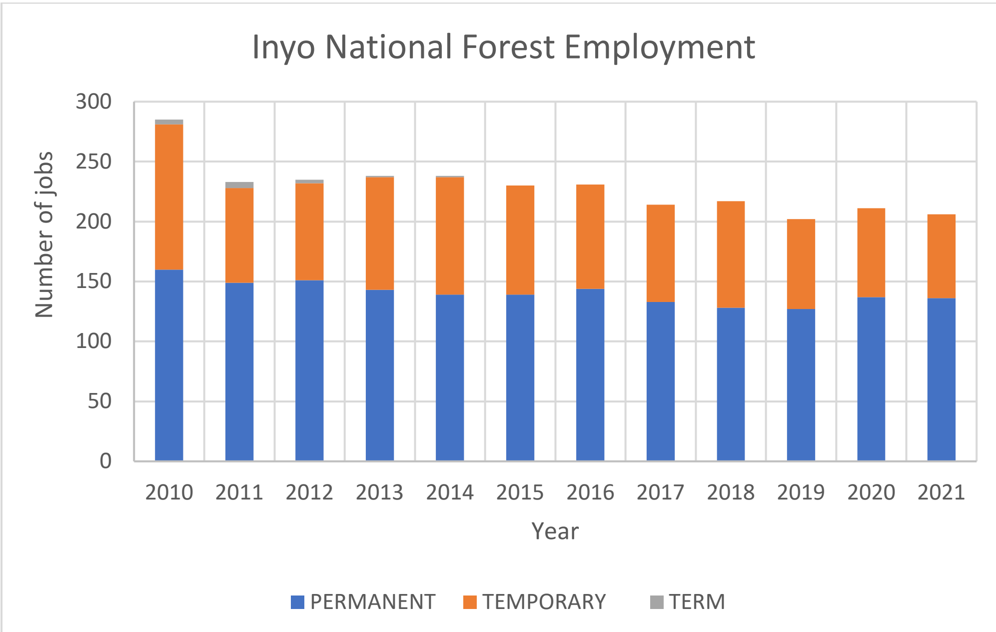



*Figure 58. Number of permanent, term and temporary employees on the Inyo National Forest from 2010 through 2021. Term positions are one to four year positions.*

The number of jobs on the Inyo National Forest has gradually decreased between 2010 and 2021. This follows the trend of overall federal government jobs in Inyo and Mono Counties. We did not obtain data before 2010. However, it is likely that, due to government stimulus programs, 2009 and 2010 had more Forest employment than previous years, so the high in 2010 shown here may be the exceptional year, so that the long-term trend is not as significant as shown in this chart. There is a greater decline in the number of temporary jobs than permanent jobs, which may be due mostly to a reduction in firefighting staff during the summers.

### *Recommendations*

Given the availability of new best available scientific information and the overlap of some indicators between the two questions, we are recommending combining PC01 and PC02 into the following question:

What are the economic conditions in local communities and what are the economic contributions of forest-based uses like recreation, forest products, mining and grazing, and ecological services to the local communities?

The indicators associated with this question would include: (1) local economic conditions and (2) Forest contributions.