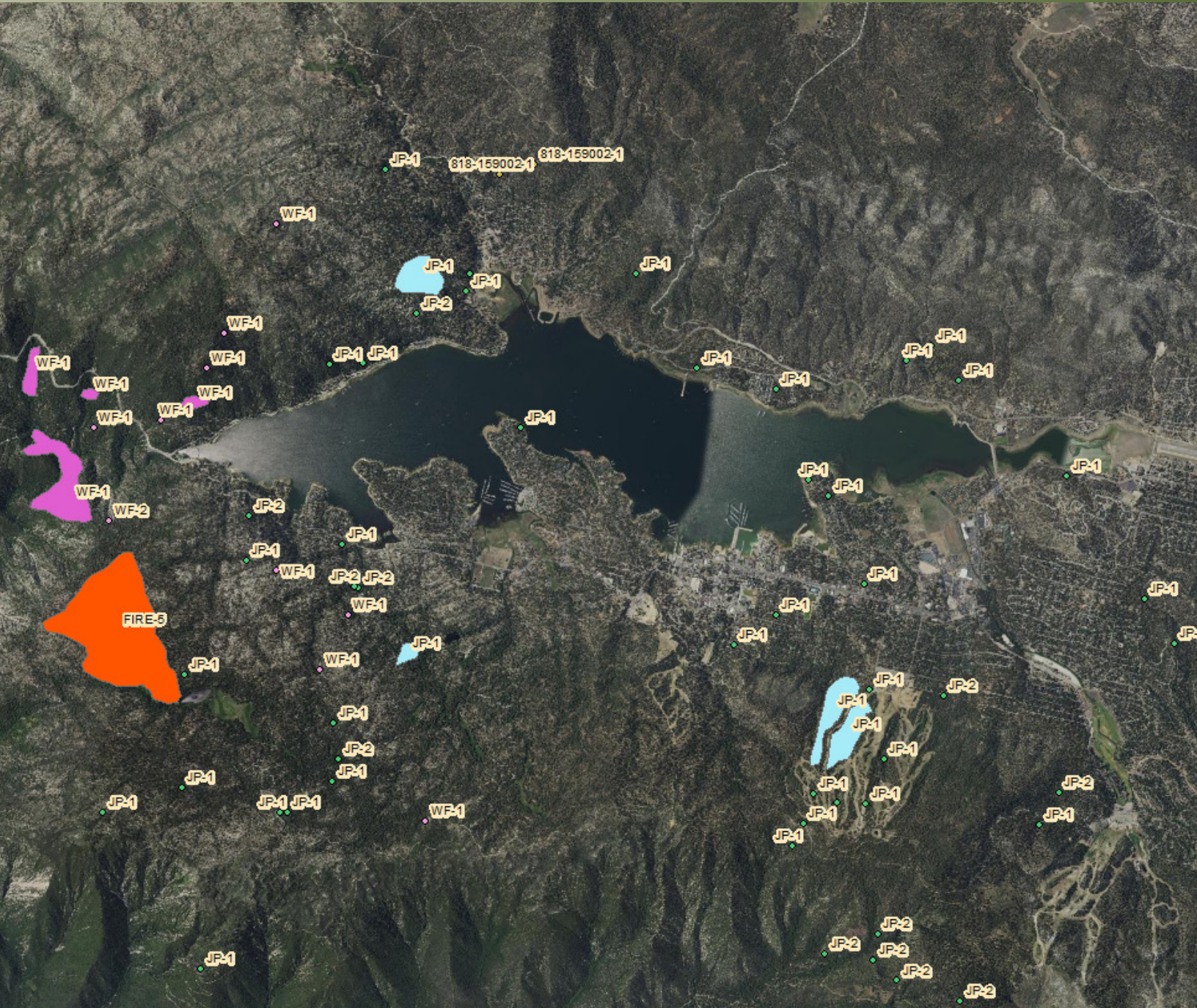




Forest Service
U.S. DEPARTMENT OF AGRICULTURE

2020 Monitoring Results: California Selected Areas of Interest



Forest Health Monitoring Program • 1731 Research Park Drive, Davis, CA 95618
www.fs.usda.gov/detail/r5/forest-grasslandhealth

COVER PHOTO

Cover image is a screen shot of Area of Interest (AOI) 3 which includes Big Bear Lake and surrounding communities within the San Bernardino National Forest. A number of different forest disturbance agents are typically detected in this area.

Zoom level is at 50,000, which is similar to actual Aerial Detection survey. Scan and sketch monitoring was accomplished using a 6,000-10,000 zoom factor in order to discern individual trees.

The image was collected in June 2020 by NAIP (National Agriculture Inventory Program).

Prepared by:

Jeffrey Moore¹
Kayanna Warren¹
Meghan Woods³

Contributors

Remote Sensing Surveyors:

Beverly Bulaon¹
Kim Corella²
Ashley Hawkins¹
Andrea Hefty¹
Stacy Hishinuma¹
Chris Lee²
Loren MacAfee⁵
Stephen McKelvey⁵
Jeffrey Moore¹
Cynthia Snyder¹
Micha Salomon⁴
Nicholas Stevens¹
William Woodruff¹

GIS and Imagery Support:

David Greenberg³
Micha Salomon⁴
Nicholas Stevens¹
Kayanna Warren¹
Meghan Woods³

Contributing Editors:

Kayanna Warren¹
Sheri Smith¹

¹USDA Forest Service

²CALFIRE

³Mason, Bruce & Girard

⁴Sanborn Map Company

⁵Quercus Consultants

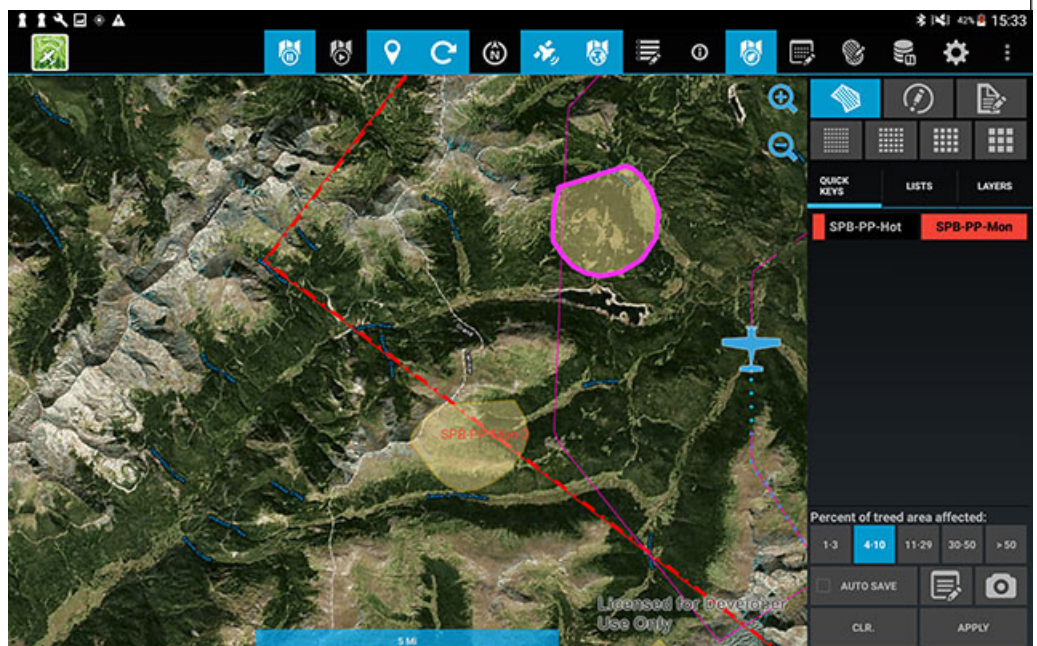


Photo of the Digital Mobile Sketchmapping System (DMSM) used to record tree mortality and damage data

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Ave, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

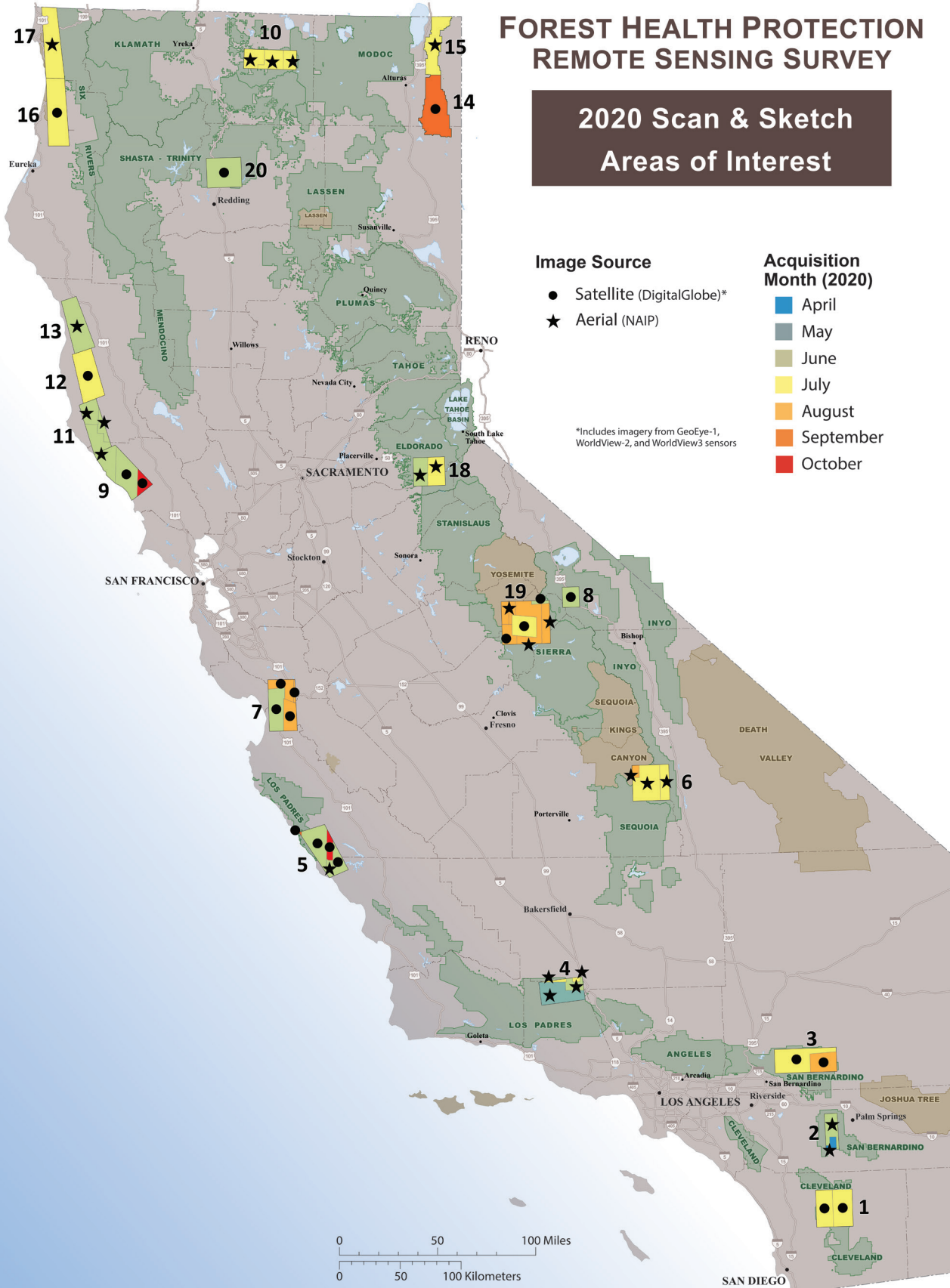
2020 Remote Sensing Results: California

Contents

Area of Interest Map	4
Summary of Findings	5
Summary of Methods	5
AOI Summaries and Maps	6
Further Information about 2020 Remote Sensing	26

FOREST HEALTH PROTECTION REMOTE SENSING SURVEY

2020 Scan & Sketch Areas of Interest



Summary of Findings

- In the AOIs scanned, mortality was generally down from 2019 levels with a few exceptions:
 - Native agents: Fir mortality increased in AOI 6, lodgepole pine mortality increased in AOI 8, ponderosa pine mortality increased around the edges of previous fires in AOI20 and remained stable in AOIs 10 and 19, and white pine mortality was consistent in AOI 15.
 - Non-native agents: Tanoak mortality attributed to Sudden Oak Death was down over most AOIs, with the exception of two AOIs where the disease was first confirmed in 2019, allowing for attribution in 2020 monitoring efforts.
 - Other: Unattributed tanoak mortality increased. Forest health teams are investigating the causes.
- Notes: About 10% of the usual survey area was monitored in 2020. The 2020 monitoring methodology was less conducive to detecting most other host species non-mortality damage.

Summary of Methods

The USDA Forest Service, Pacific Southwest Region normally conducts annual aerial surveys throughout forested areas of California to detect recently killed and damaged forest trees. However, due to safety concerns during the COVID-19 global pandemic in 2020, aerial surveys were suspended. Thus the Region shifted to monitor forest health conditions using other remote sensing methods.

In 2020¹, 13 forest health specialists virtually surveyed approximately 3.8 million acres utilizing either touch tablets or computers to assess recent satellite or National Agriculture Imagery Program (NAIP) aerial images and digitally sketch points and polygons of tree damage – mostly mortality.

This report documents the observations made in California in 2020 with alternative methods. Please note that these differences from previous years may reflect to some degree a difference in methodology as much as a change in host or agent presence or severity. Other factors that may have played into different results from 2019 include: multiple observers in 2020, different months imagery was gathered versus flights, and variation in clarity of image sharpness and color.

Acreage and totals by species are not directly comparable to past years because it was often difficult to discern individual tree species even at 30-60cm resolution and therefore make appropriate inferences about agent and mortality stage (recent or old). Additionally, fir's more subtle color signature and more numerous sub-canopy presence made mortality more challenging to detect in 2020 with this methodology.

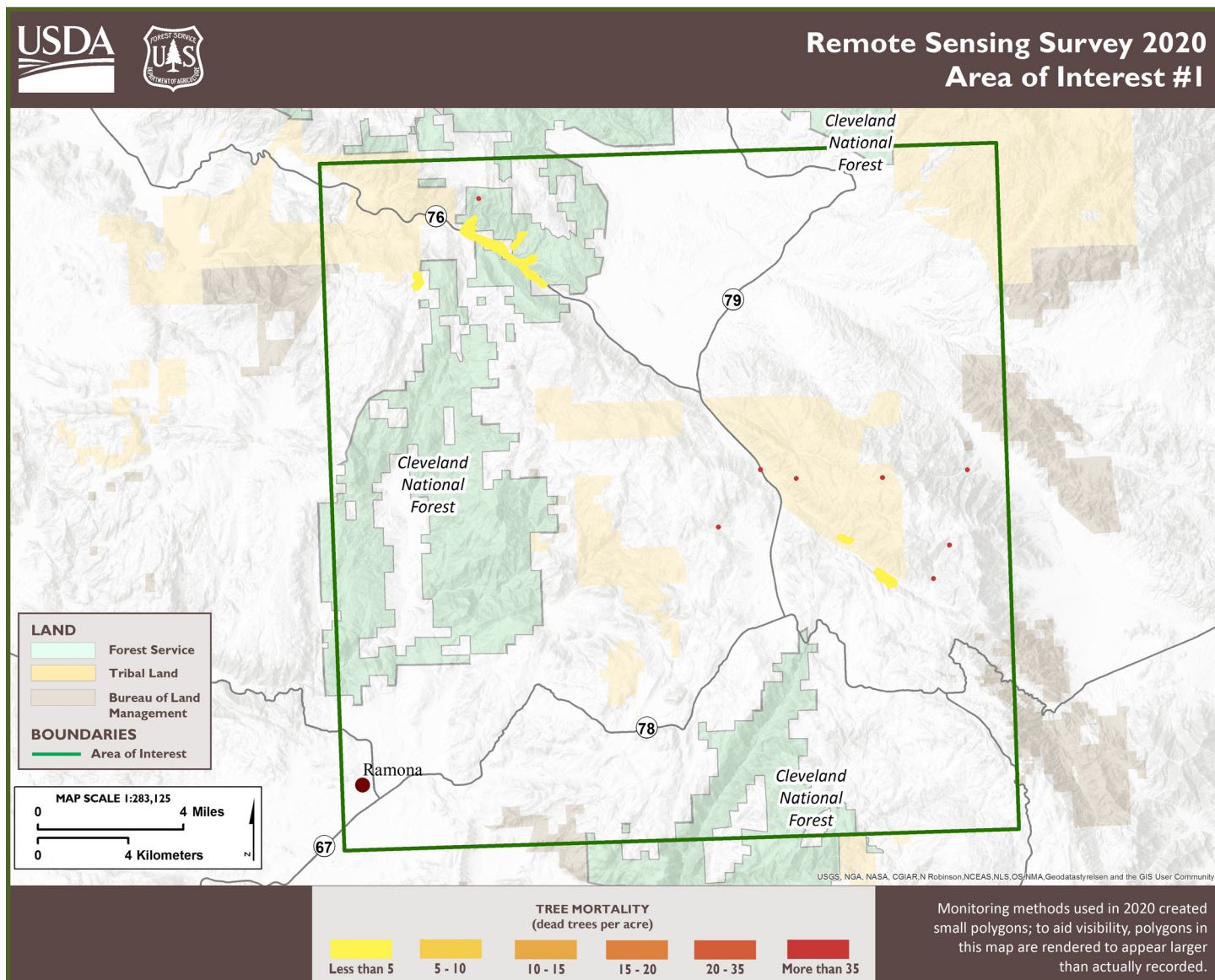
If tree host species and agent are not included in the tables below, they were either not detected or were at very low numbers (fewer than 100 trees in 2020 and in 2019). Host species with fewer than 100 trees in 2020 are presented in the area of interest (AOI) tables when 2019 levels were more than 100 trees.

For more information about the 2020 monitoring methods, see the Further Information Section (page 26).

¹ In 2019, aerial detection surveys (ADS) surveys were flown by 3 surveyors between July and August, surveying ~41 million acres of forested land in California. Additionally, field staff conducted ground checks on selected points and polygons to verify host and agent.

Results by AOI: 1

Land Ownership: Bureau of Land Management (BLM), County Parks, Cleveland National Forest (NF), private land, Tribal Land

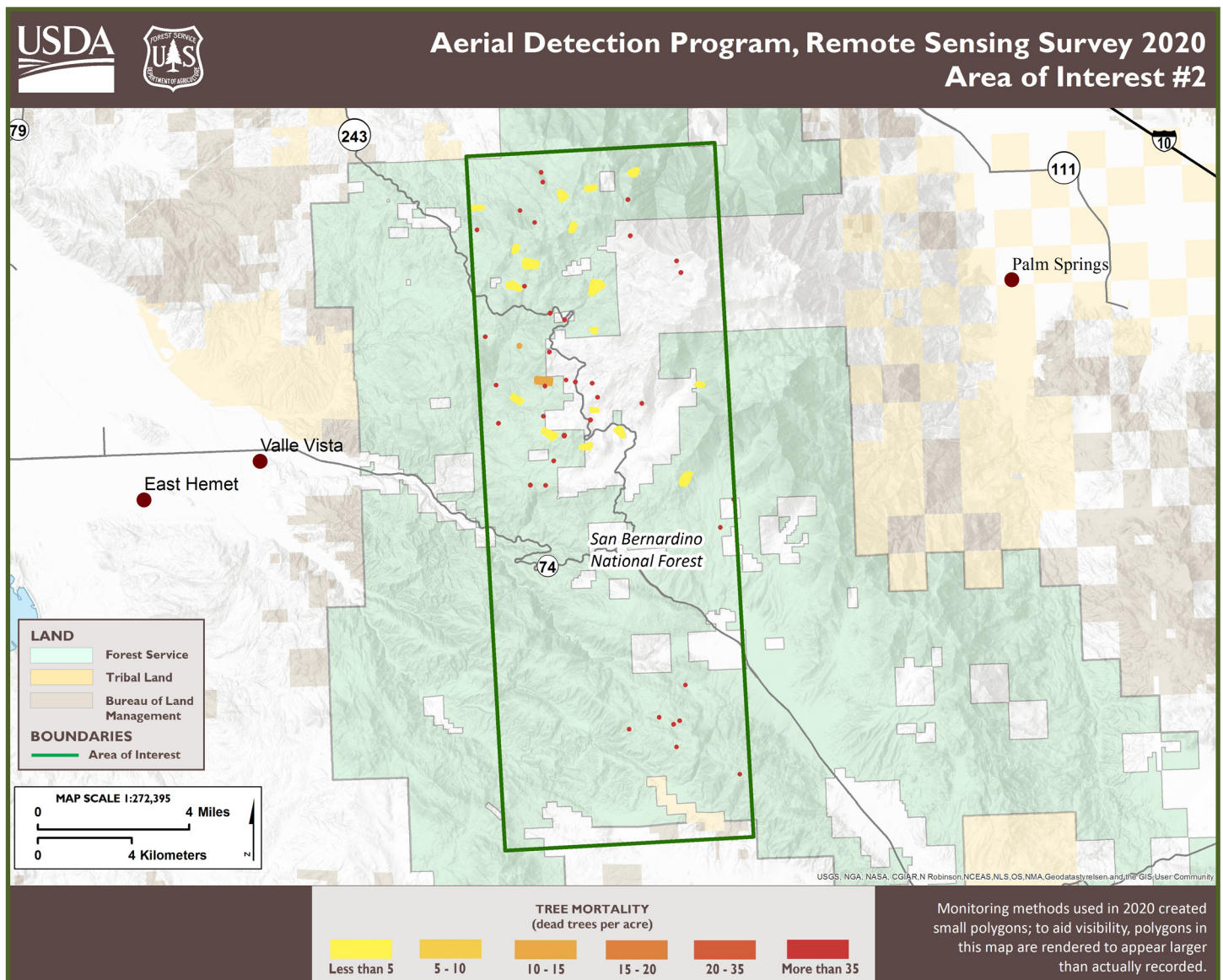


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Oak (<i>Quercus</i> spp.) - goldspotted oak borer (<i>Agrilus auroguttatus</i>)	San Diego	1,100	decrease

In 2020, new oak mortality was again detected but possibly at lower levels than in recent years. NAIP imagery used for analysis in 2020 was taken early in the year (before June) and may not have captured most of the mortality that occurred in 2020.

Results by AOI: 2

Land Ownership: private land, San Bernardino NF, Tribal Land

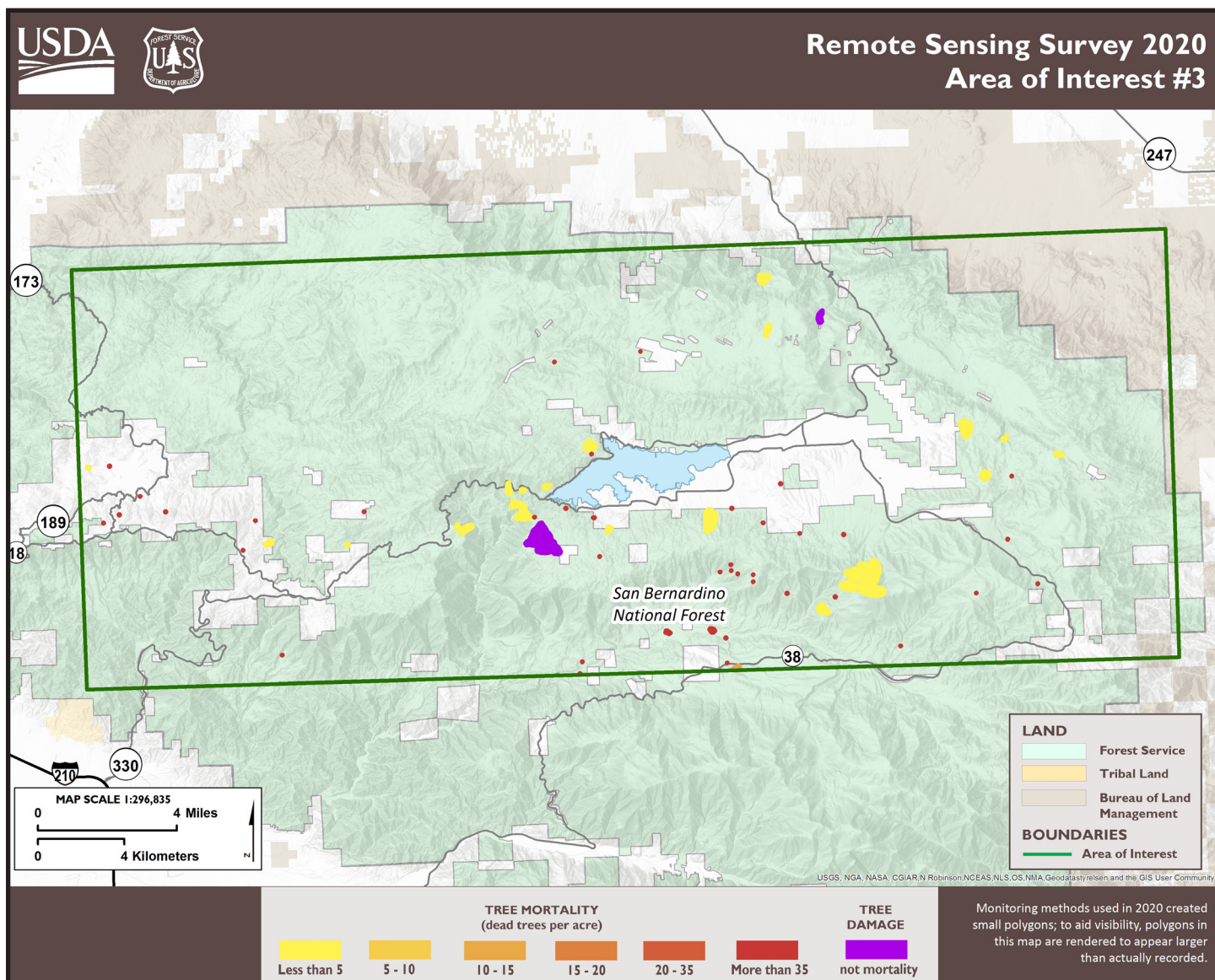


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine (Jeffrey pine (<i>Pinus jeffreyi</i>) and ponderosa pine (<i>Pinus ponderosa</i>)) – Jeffrey pine beetle (<i>Dendroctonus jeffreyi</i>) or western pine beetle (<i>Dendroctonus brevicomis</i>)	Riverside	400	decrease
White fir (<i>Abies concolor</i>) – fir engraver (<i>Scolytus ventralis</i>)	Riverside	500	decrease

Significant amounts of white fir and Jeffrey pine mortality continue in AOI 2, though mortality in 2020 appeared to be down from 2019 levels.

Results by AOI: 3

Land Ownership: BLM, private land, San Bernardino NF

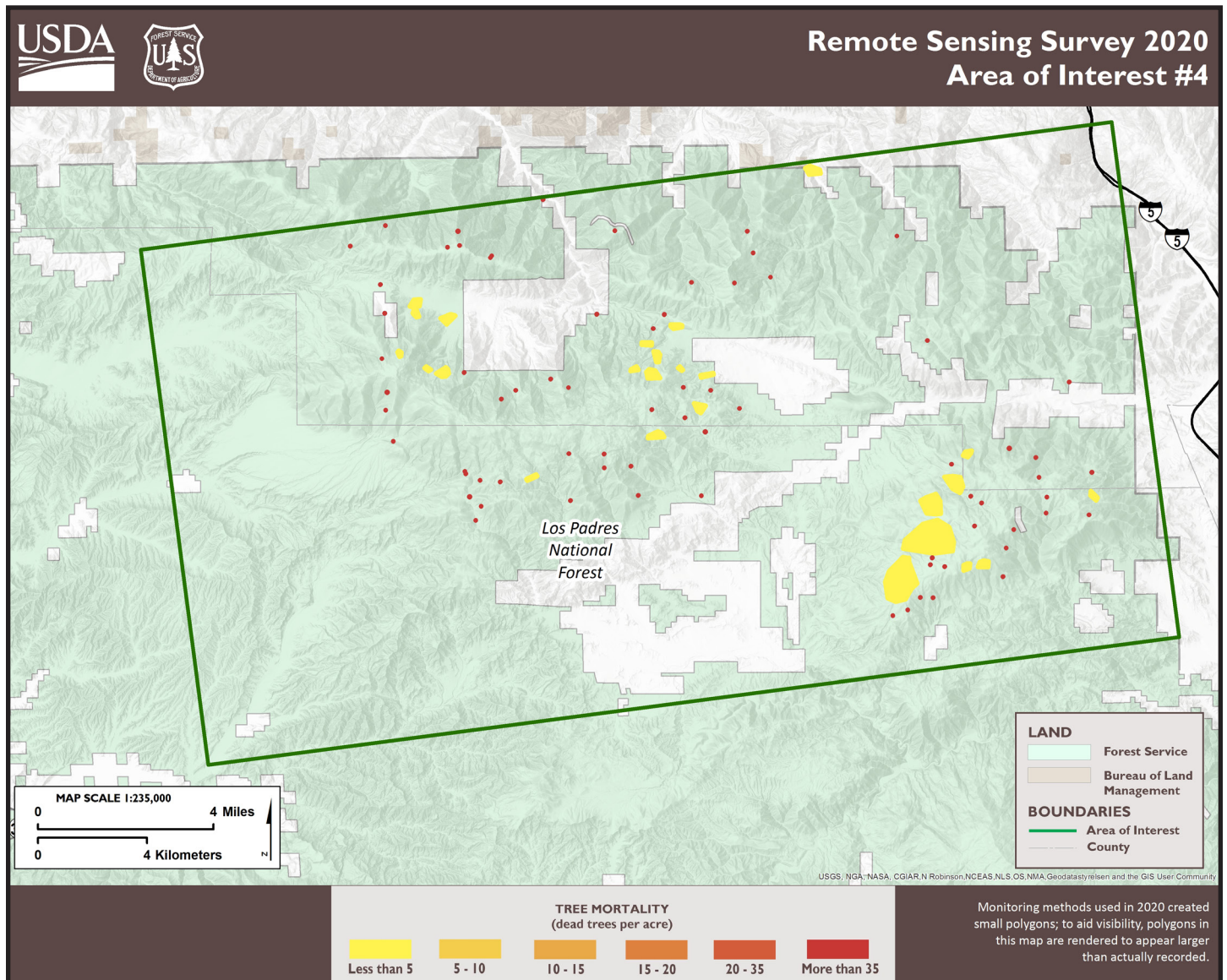


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	San Bernardino	1,000	decrease
White fir – fir engraver	San Bernardino	300	decrease

Significant amounts of white fir and Jeffrey pine mortality continued in western portions of AOI 3, though mortality in 2020 appeared to be down from 2019 levels. Non-mortality damage was due to wildfire and affected all tree species.

Results by AOI: 4

Land Ownership: Los Padres NF, private land, State Park

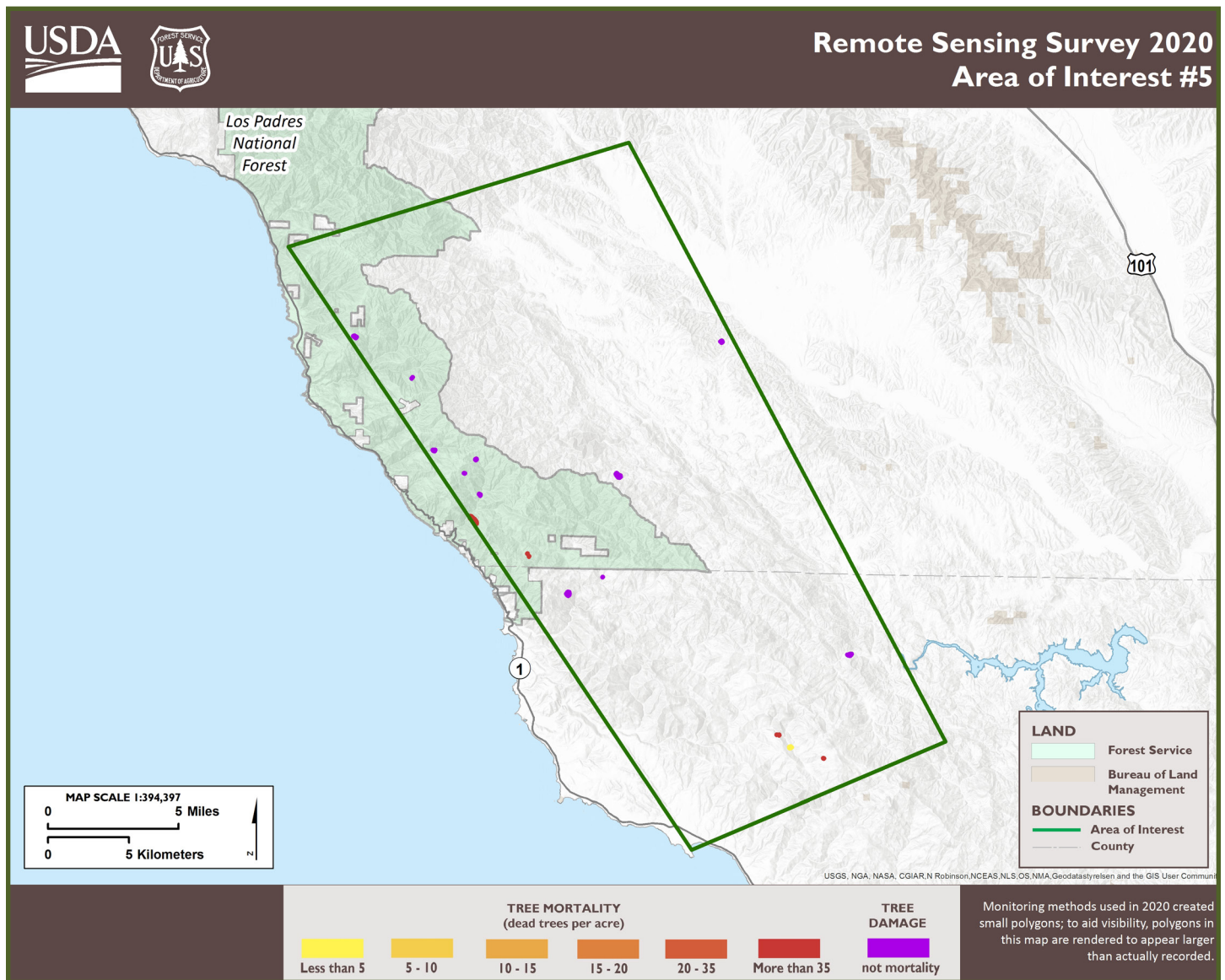


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Jeffrey pine – <i>Ips</i> spp.	Ventura Kern	2,700	decrease
White fir – fir engraver	Ventura Kern	<100	decrease

Significant mortality of Jeffrey pine continued in 2020, though at reduced levels from 2019.

Results by AOI: 5

Land Ownership: BLM, Department of Defense, Los Padres NF, private land

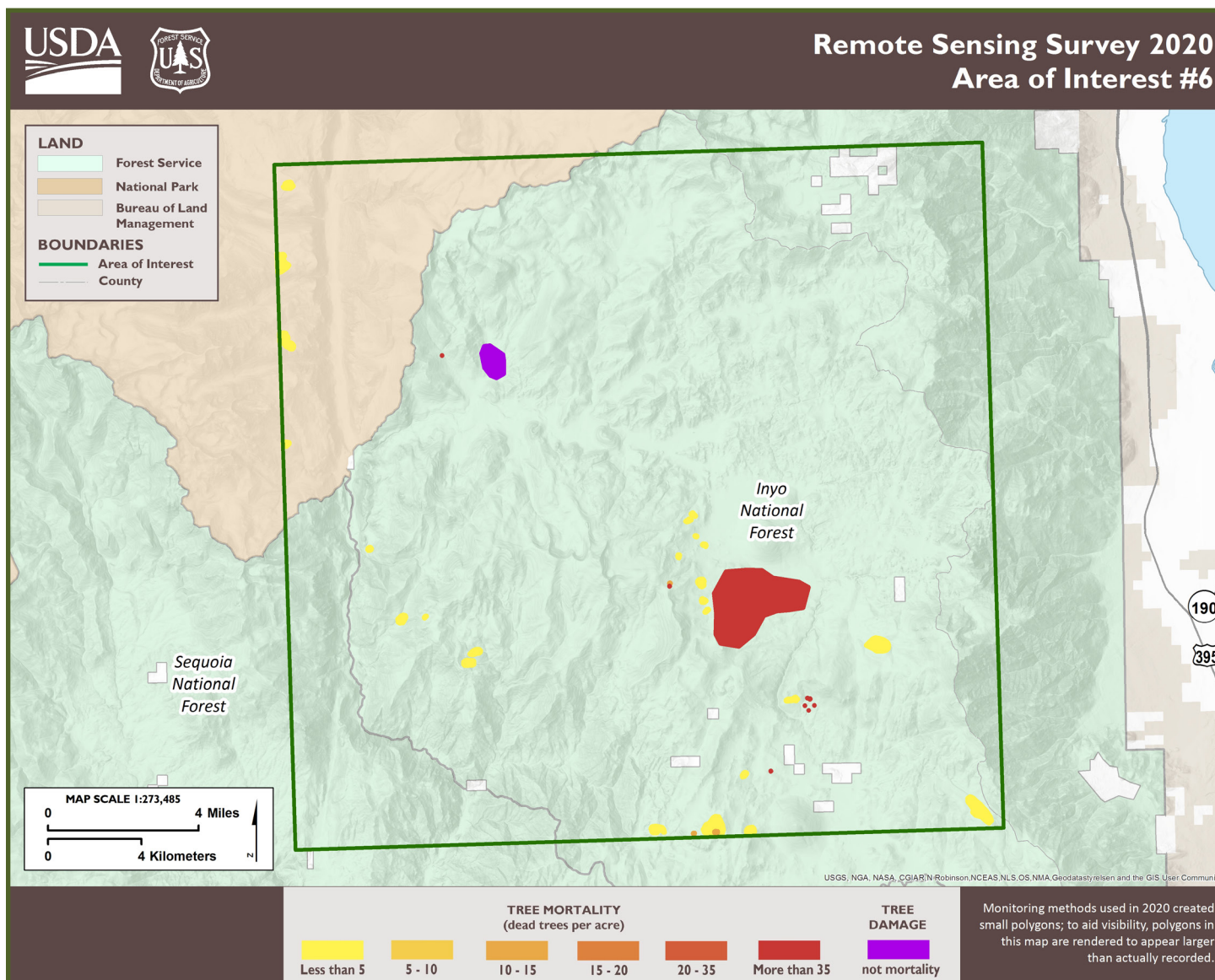


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Oak (<i>Quercus</i> spp.) Mortality - GSOB	Monterey, San Luis Obispo	<100	Decrease
tanoak (<i>Notholithocarpus densiflorus</i>) – Sudden Oak Death (<i>Phytophthora ramorum</i>)	Monterey, San Luis Obispo	700	Decrease

Low levels of scattered gray pine (*Pinus sabiniana*) mortality was detected in both years. Non-mortality damage is crown dieback in gray pine; dieback and discoloration in tanoak, live oak and other hardwoods; and wildfire affecting all tree species. About 7% of this AOI was later affected by the Dolan Fire after the damage shown on this map was recorded.

Results by AOI: 6

Land Ownership: BLM, Inyo NF, private land, Sequoia NF, Sequoia-Kings Canyon NP

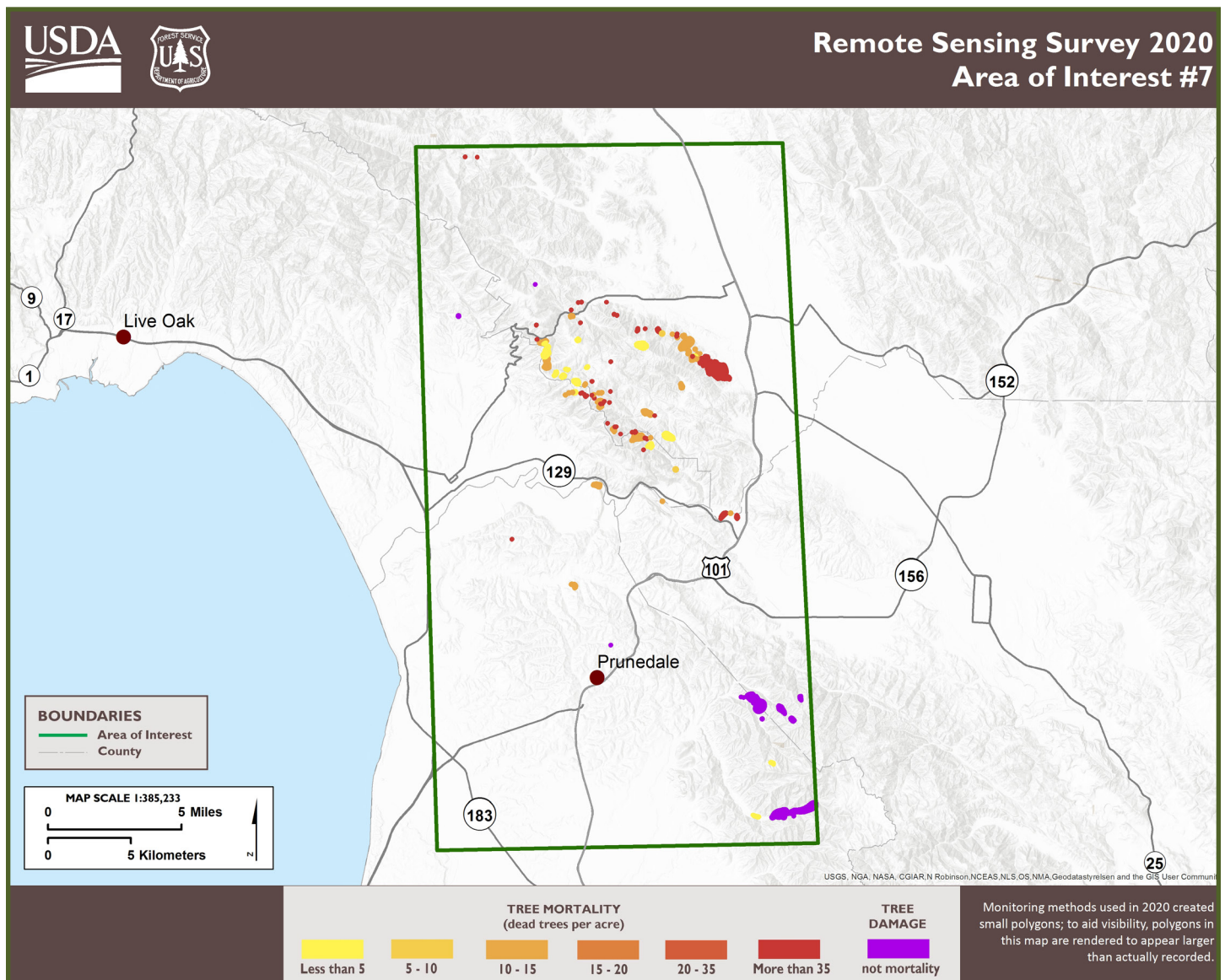


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	Tulare Inyo	<100	decrease
Lodgepole pine (<i>Pinus contorta</i>) and limber pine (<i>Pinus flexilis</i>) – mountain pine beetle (<i>Dendroctonus ponderosae</i>)	Tulare Inyo	<100	decrease
white fir and red fir (<i>Abies magnifica</i>) – fir engraver	Tulare Inyo	181,200	increase

Mortality in white and red fir attributed to fir engraver increased in AOI 6. Jeffrey pine and ponderosa pine mortality was lower. ADS in 2019 and RS in 2020 also detected some isolated areas of high-elevation five needle pine mortality. Non-mortality damage was due to wildfire and affected all tree species. About 15% of this AOI was affected by the SQF Complex after the damage shown on this map was recorded.

Results by AOI: 7

Land Ownership: BLM, County Parks, private land

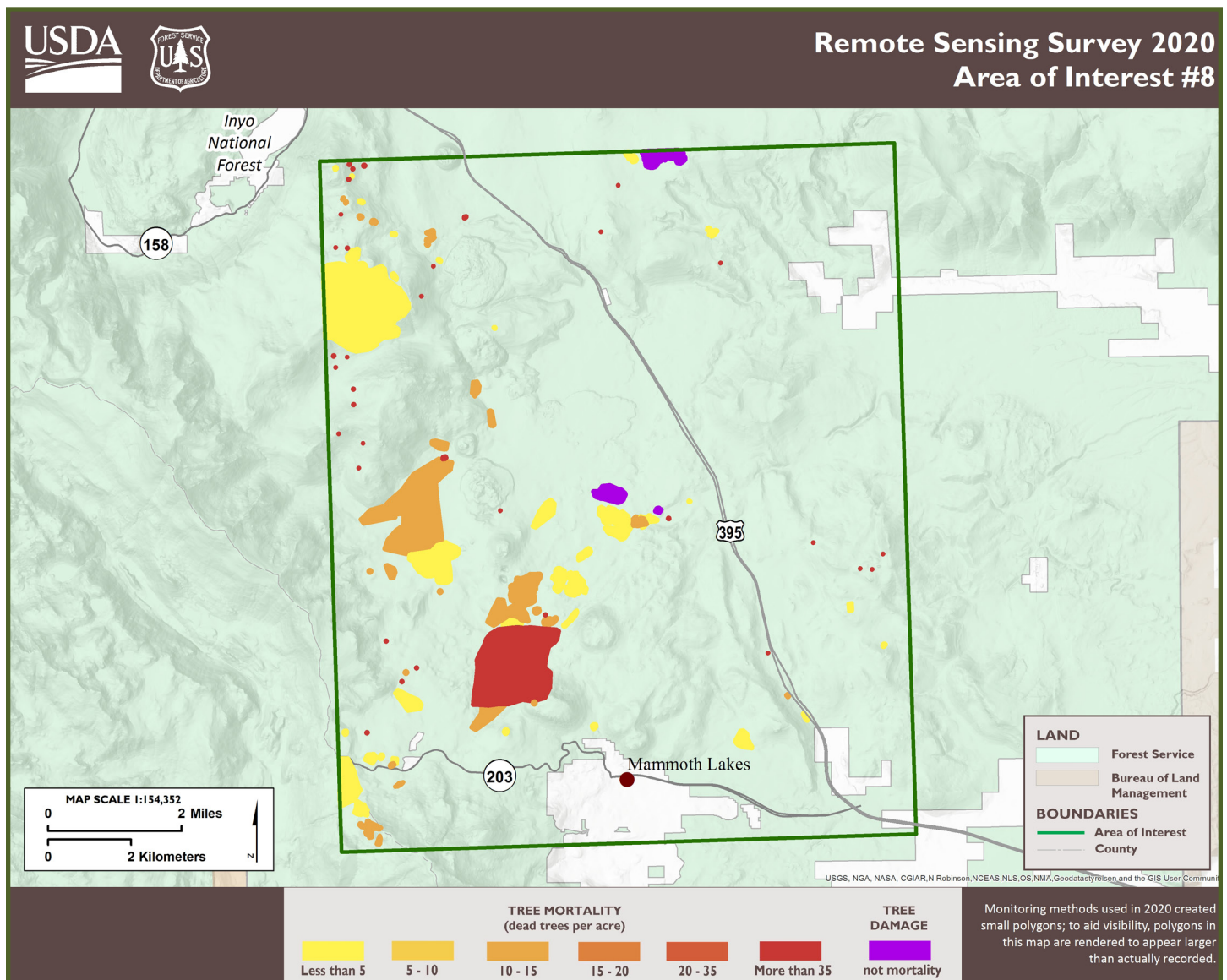


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Oak (<i>Quercus</i> spp.) Mortality - unknown (UNK)	Santa Cruz Santa Clara San Benito Monterey	13,500	consistent
tanoak – Sudden Oak Death and UNK	Santa Cruz Santa Clara San Benito Monterey	1,700	decrease

AOI 7 continued recent years' elevated oak and tanoak mortality, though tanoak mortality appeared to be reduced. Non-mortality damage was crown discoloration of oaks and other hardwoods and defoliation of unknown hardwood species.

Results by AOI: 8

Land Ownership: Inyo NF, private land

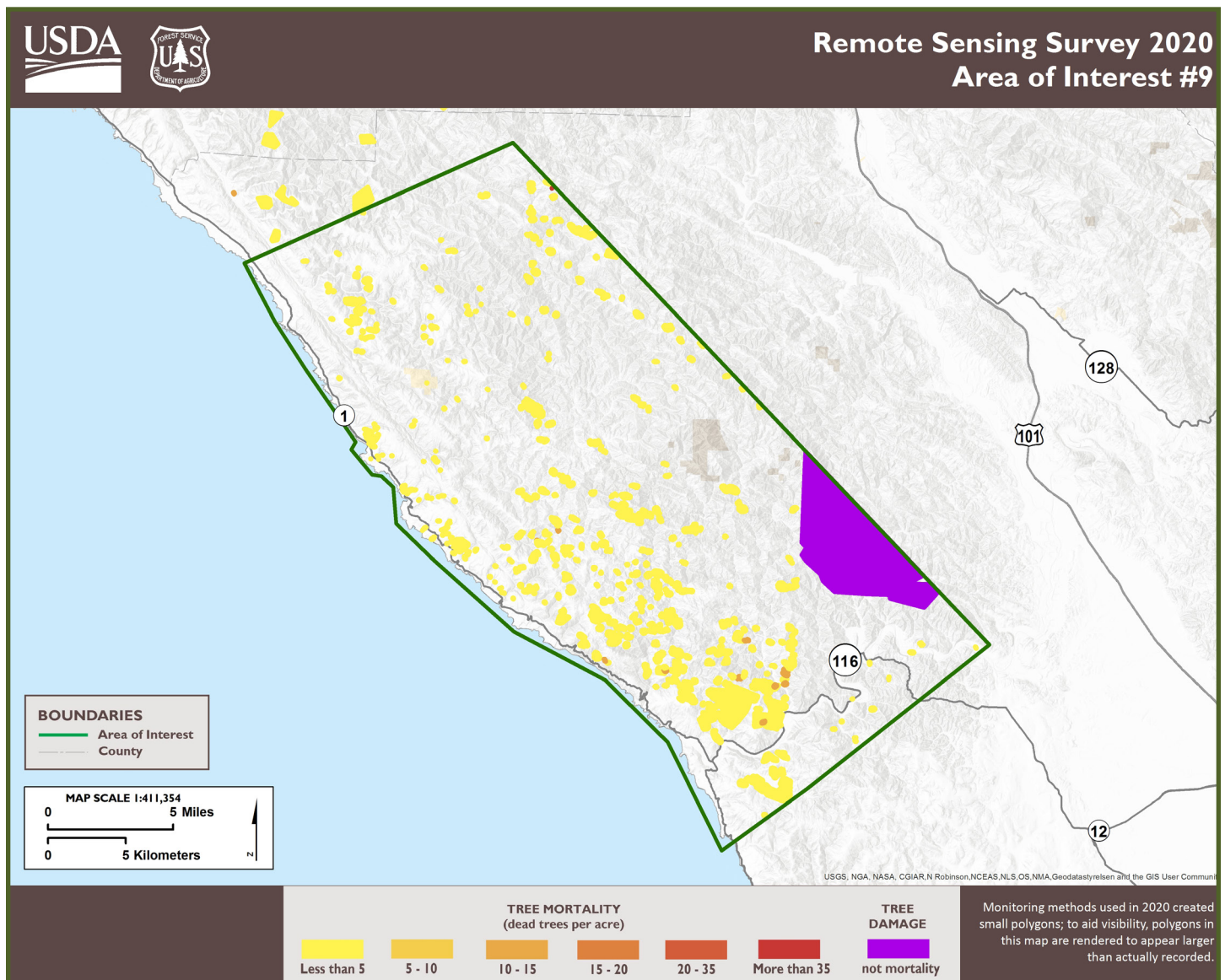


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
yellow pine – pine beetle	Mono Madera	2,000	decrease
limber pine, western white pine (<i>Pinus monticola</i>), whitebark pine (<i>Pinus albicaulis</i>) – mountain pine beetle	Mono Madera	600	decrease
Lodgepole pine – mountain pine beetle	Mono Madera	34,200	increase
red fir – fir engraver	Mono Madera	8,200	decrease

Monitoring in 2020 detected considerable ongoing but reduced amounts of California red fir mortality in AOI 8. Non-mortality damage was due to wildfire affecting all tree species and branch flagging in live oak.

Results by AOI: 9

Land Ownership: BLM, private land, State Parks and Recreation, Tribal Land

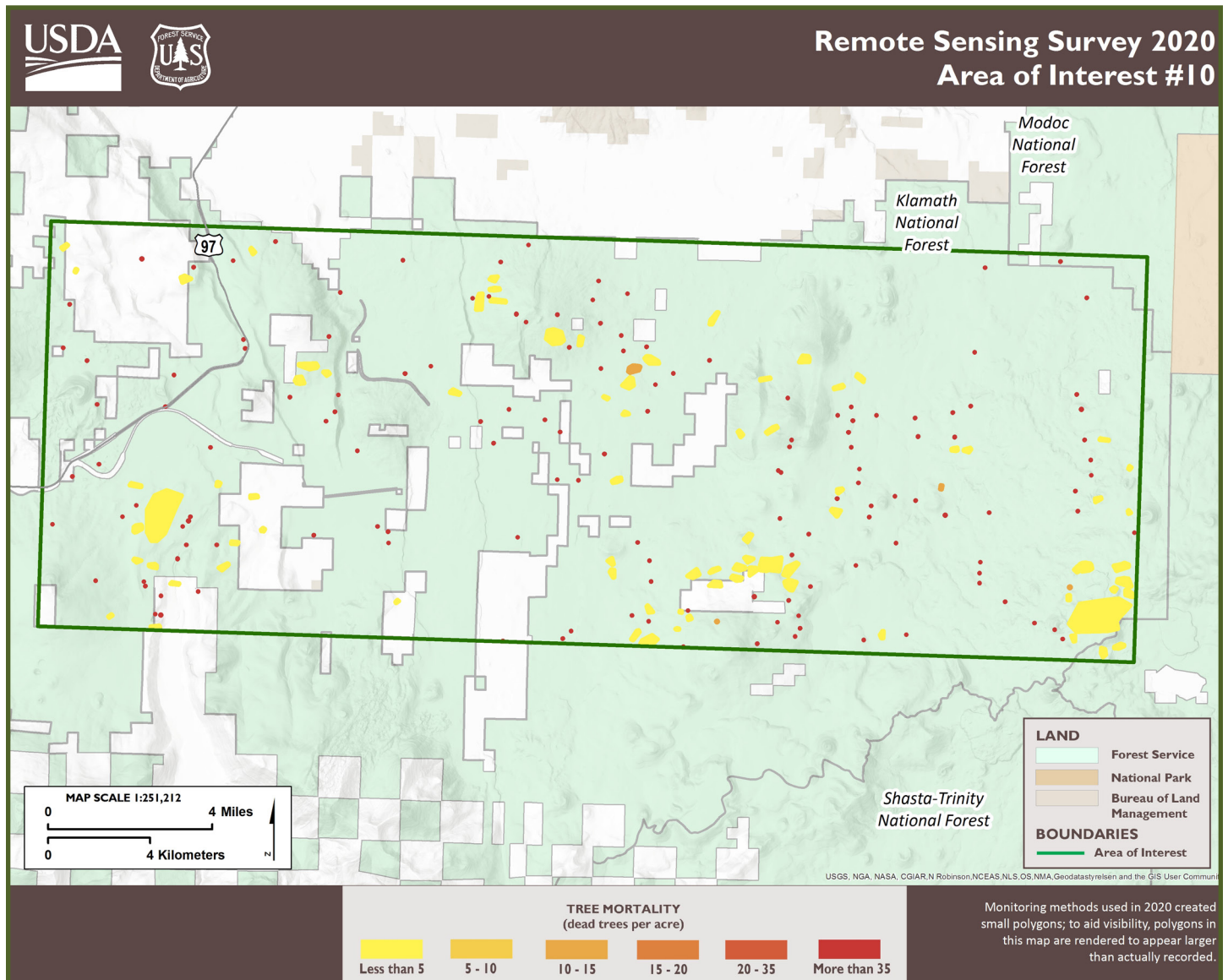


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Douglas-fir (<i>Pseudotsuga menziesii</i>) – flatheaded fir borer (<i>Phaenops drummondi</i>)	Sonoma	<100	decrease
tanoak – Sudden Oak Death	Sonoma	11,600	decrease

Non-mortality damage was due to wildfire and affected all tree species. The large area of fire damage shown in the southeast corner of the map was part of the 2020 LNU Complex Fire that occurred before monitoring was conducted in this AOI.

Results by AOI: 10

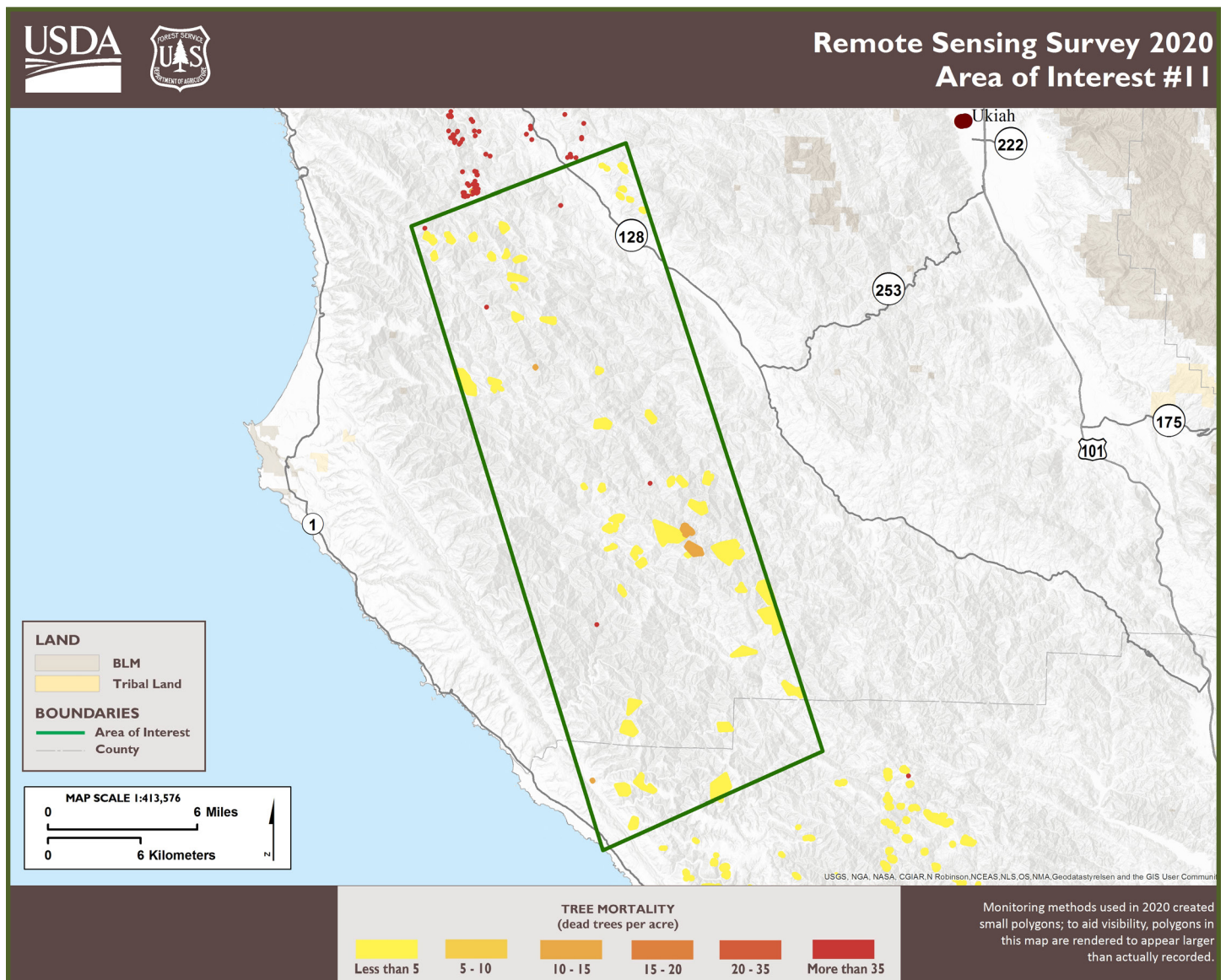
Land Ownership: Klamath NF, private land



Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	Siskiyou	2,100	consistent
White and red fir – fir engraver	Siskiyou	2,400	decrease

Results by AOI: 11

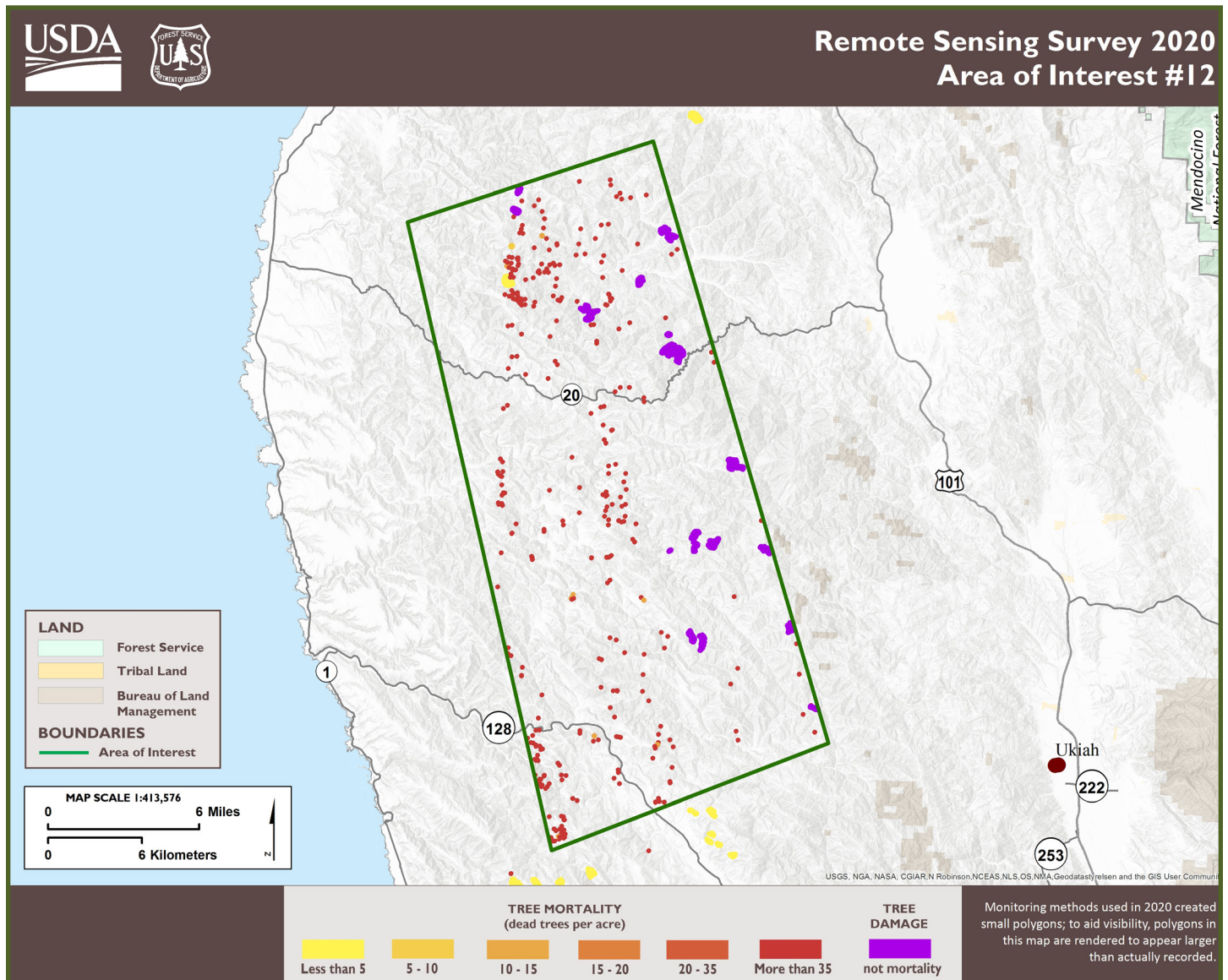
Land Ownership: private land, State Parks



Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Bishop pine (<i>Pinus muricata</i>) - UNK	Mendocino Sonoma	<100	decrease
Douglas-fir (<i>Pseudotsuga menziesii</i>) - flatheaded fir borer (<i>Phaenops drummondi</i>)	Mendocino Sonoma	<100	decrease
tanoak - Sudden Oak Death	Mendocino Sonoma	8,200	decrease

Results by AOI: 12

Land Ownership: private land, State Forest

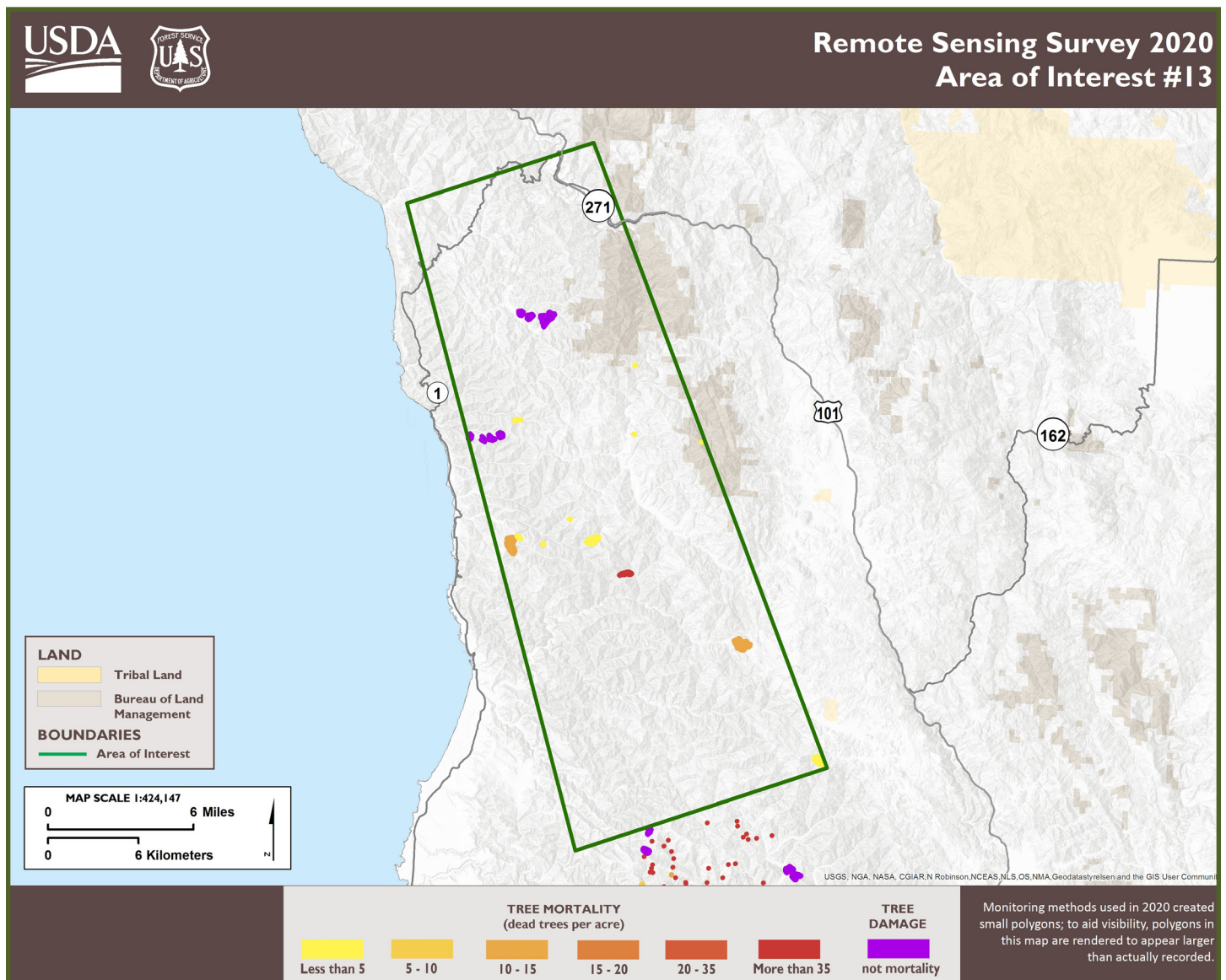


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
tanoak – Sudden Oak Death	Mendocino	300	decrease

Non-mortality damage was due to wildfire affecting all tree species, intentional herbicide damage in tanoak, and bear feeding damage in young plantation redwood and Douglas-fir.

Results by AOI: 13

Land Ownership: BLM, private land, State lands

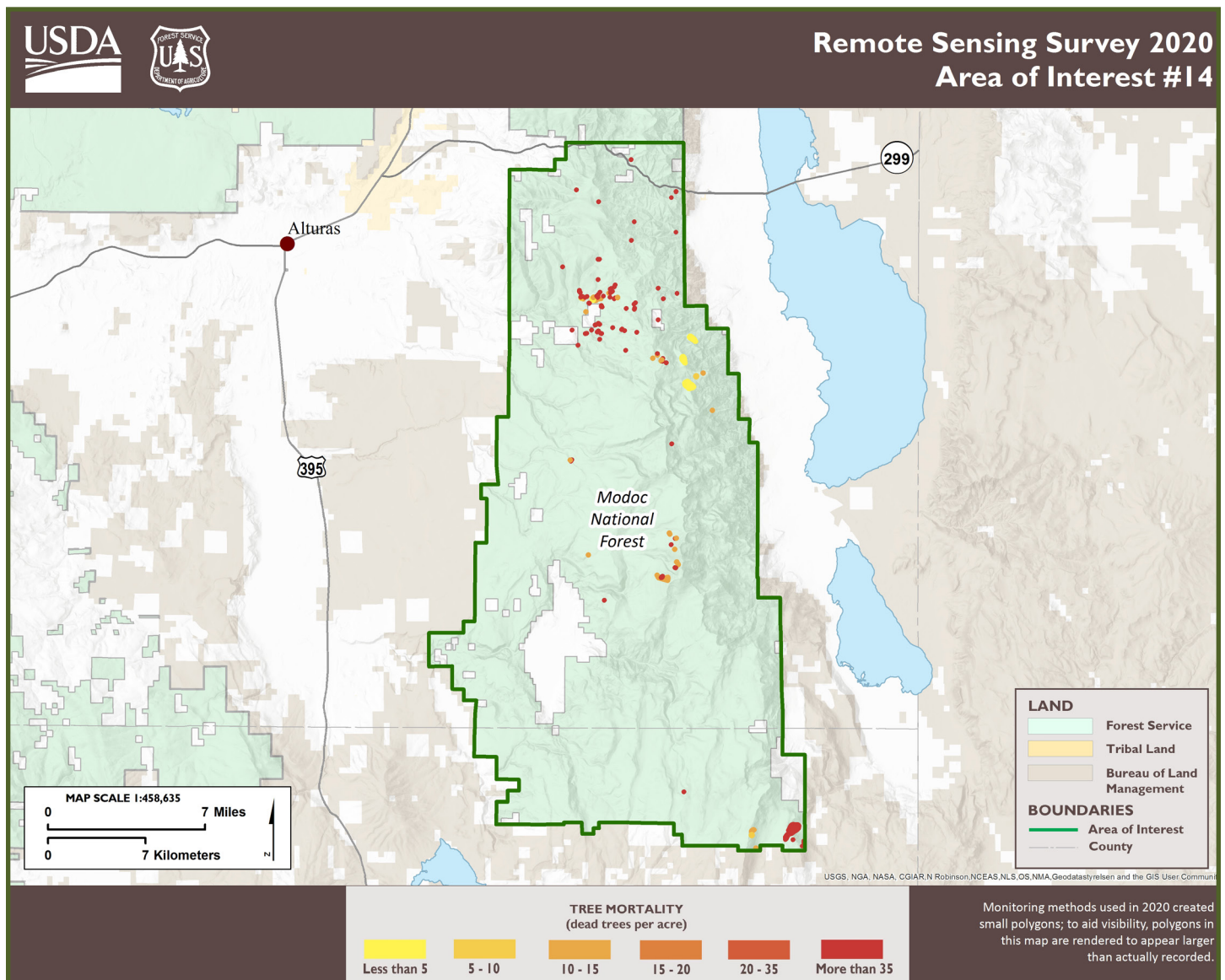


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
tanoak – Sudden Oak Death (SOD)	Mendocino	<100	decrease
tanoak – UNK	Mendocino	5,400	increase

Tanoak mortality outside of known SOD infestation areas increased. Total tanoak mortality increased in 2020 in this AOI. Forest health teams continue to investigate causes of this unknown tanoak mortality increase. Non-mortality damage was intentional herbicide damage in tanoak.

Results by AOI: 14

Land Ownership: BLM, Modoc NF, private land

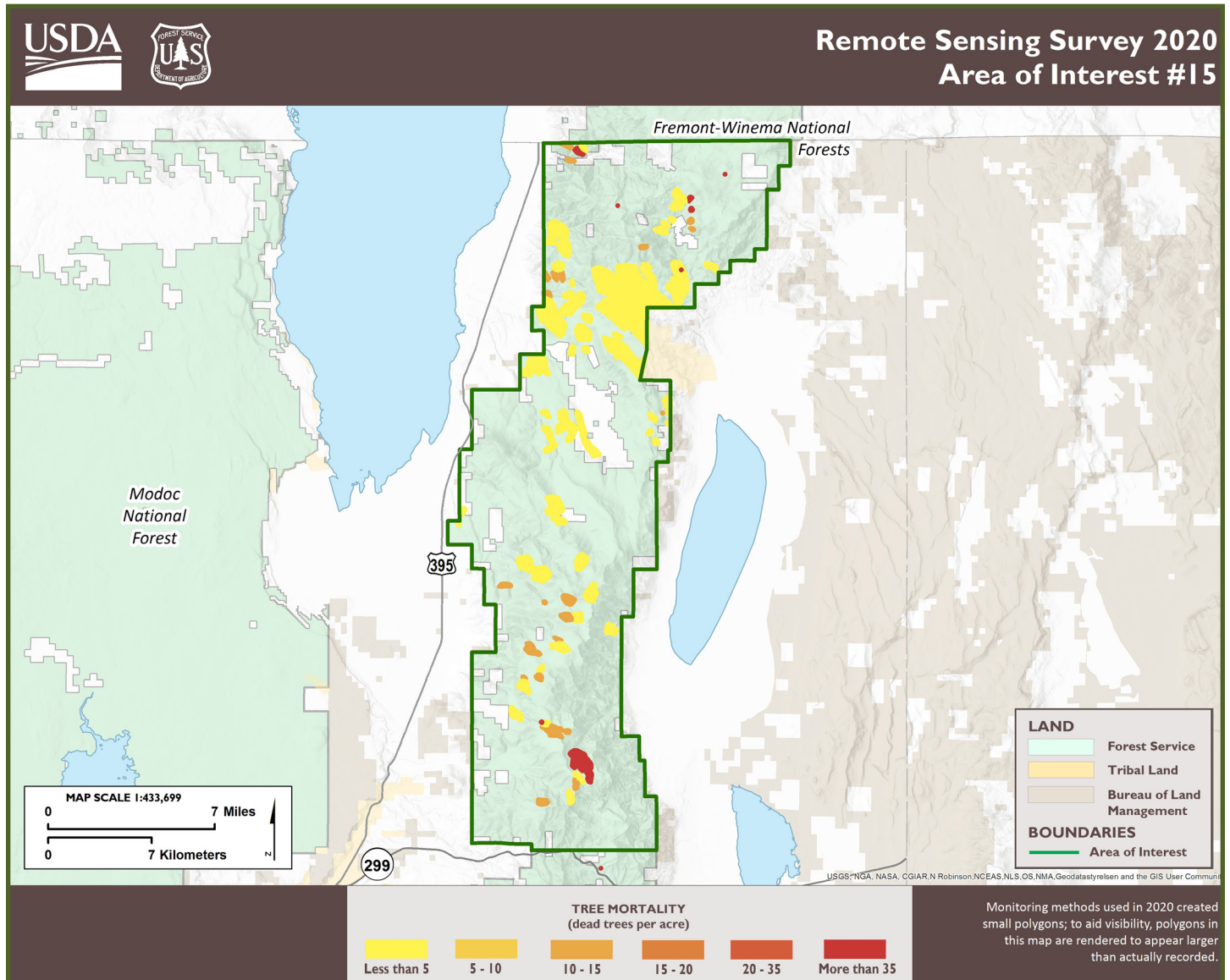


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	Modoc Lassen	8,700	increase
Western white pine, whitebark pine – mountain pine beetle	Modoc Lassen	<100	decrease
white fir – fir engraver	Modoc Lassen	<100	decrease

AOI 14 did not initially detect fir mortality when utilizing July imagery, but subsequent scans with later-season imagery detected some mortality. Quaking aspen (*Populus tremuloides*) damage due to Marssonina blight was found in 2019 but was not detected in 2020. Pine mortality increases will continue to be monitored. About 3% of this AOI was affected by the W-5 Cold Springs Fire after the features shown in this map were recorded.

Results by AOI: 15

Land Ownership: BLM, Modoc NF, Tribal Land

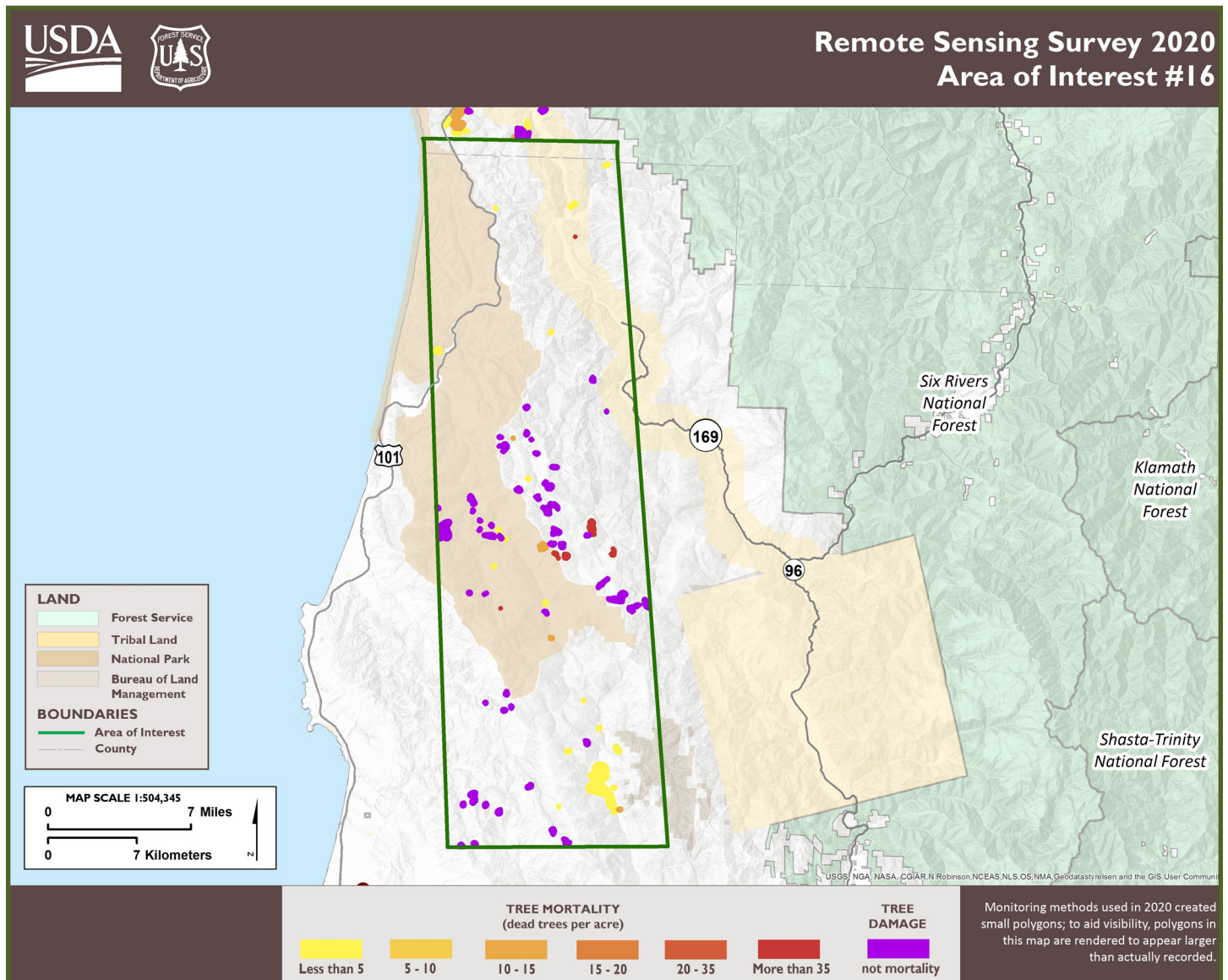


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	Modoc	2,600	slight increase
white fir – fir engraver	Modoc	43,200	decrease

Quaking aspen damage due to Marssonina blight was found in 2019 but was not detected in 2020. Pine mortality increases will continue to be monitored.

Results by AOI: 16

Land Ownership: BLM, private land, Redwood NP, State Parks, Tribal Land

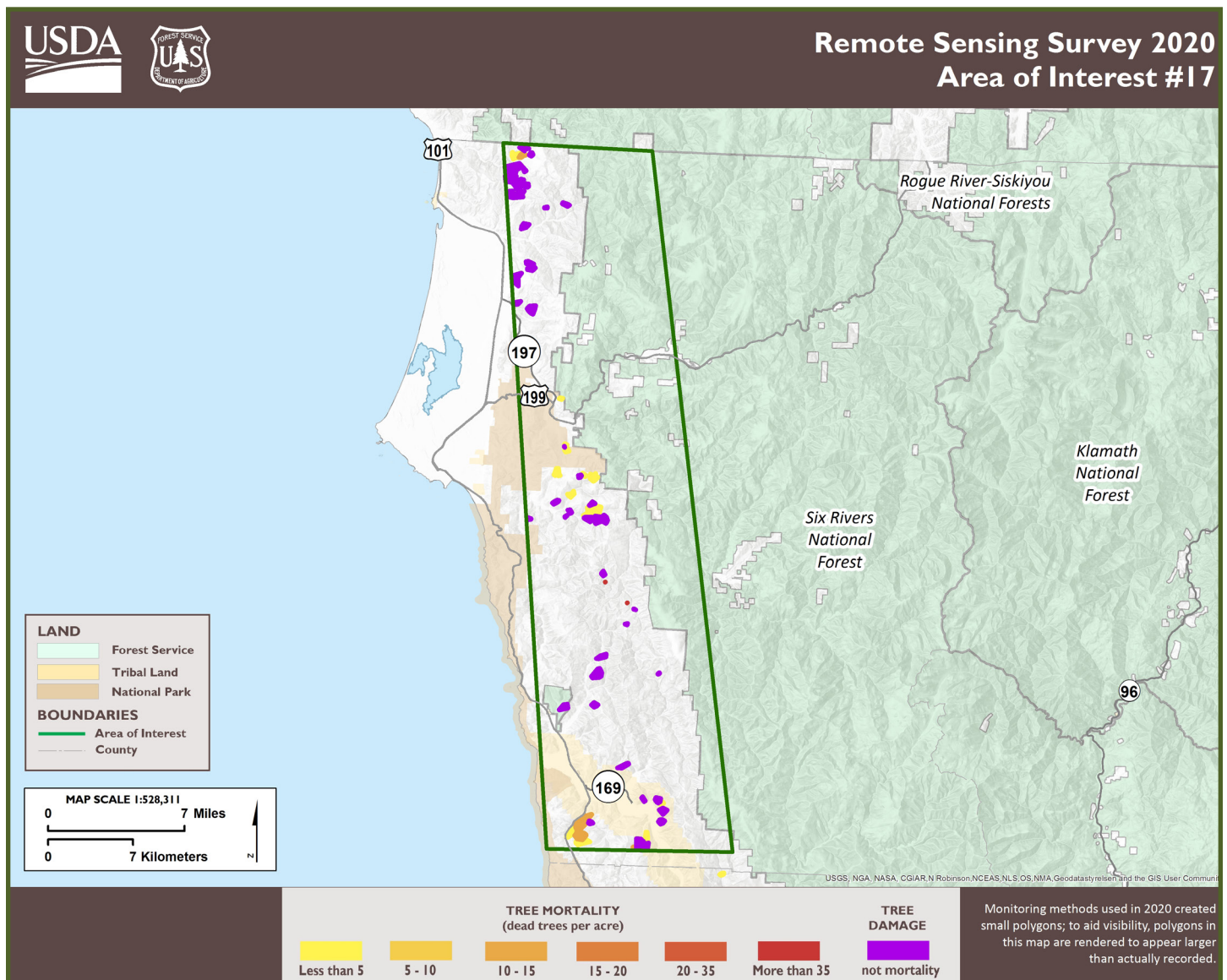


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Oak (<i>Quercus</i> spp.) - UNK	Humboldt Del Norte	300	increase
Douglas-fir – flatheaded fir borer	Humboldt Del Norte	800	decrease
tanoak – Sudden Oak Death	Humboldt Del Norte	10,300	increase – first-time attribution
tanoak – UNK	Humboldt Del Norte	1,000	decrease

In AOI 16, SOD was first confirmed in 2019 by ground personnel, allowing for attribution to SOD in 2020. Total tanoak mortality increased in 2020 over 2019. Both 2019 and 2020 also recorded scattered large Douglas-fir mortality attributable to flatheaded fir borer (*Phaenops drummondii*), but mortality appeared to be down from 2019. Bear feeding on young plantation Douglas-fir and redwood was the largest recorded damage acreage for both the 2019 ADS and the 2020 monitoring seasons in this AOI. This does not always lead to mortality and is therefore not included in the table. Non-mortality damage was intentional herbicide damage in tanoak, bear feeding damage in young plantation redwood and Douglas-fir, and topkill in redwood.

Results by AOI: 17

Land Ownership: private land, Redwood NP, Six Rivers NF, State Parks and Recreation, Tribal Land

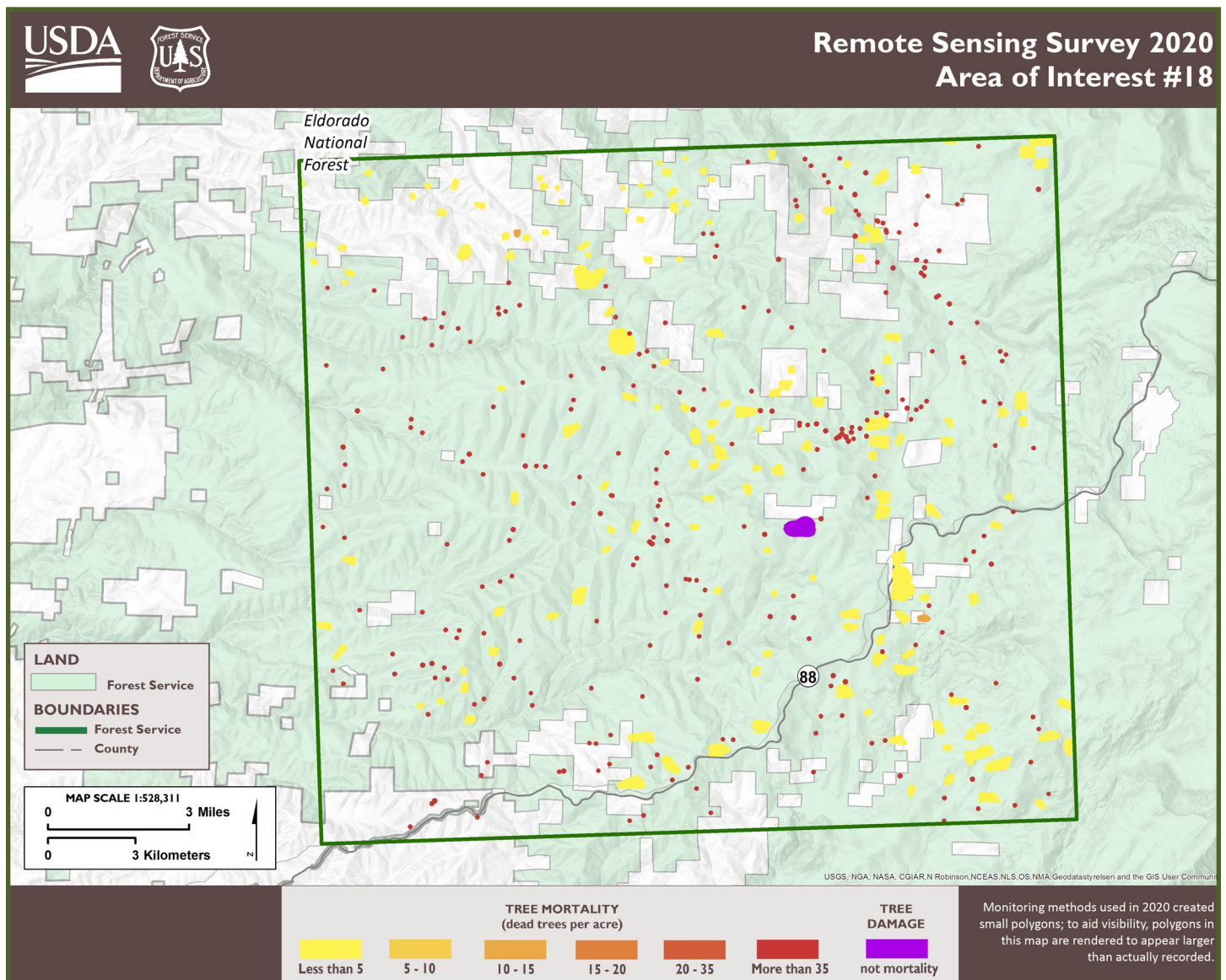


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Douglas-fir – flatheaded fir borer	Del Norte	<100	decrease
tanoak – Sudden Oak Death	Del Norte	200	increase – first-time attribution
tanoak – UNK	Del Norte	5,300	increase
White fir – fir engraver	Del Norte	<100	decrease

Bear feeding on young plantation Douglas-fir and redwood was the largest recorded damage acreage for both the 2019 ADS and the 2020 monitoring seasons. In 2020, tanoak mortality was more prevalent, with some attributed as SOD for the first time based on confirmed 2019 field SOD detections. Forest health teams continue to investigate causes of unknown tanoak mortality increases. Non-mortality damage was bear feeding damage in young plantation redwood and Douglas-fir and branch flagging in hardwood species.

Results by AOI: 18

Land Ownership: El Dorado NF, private land

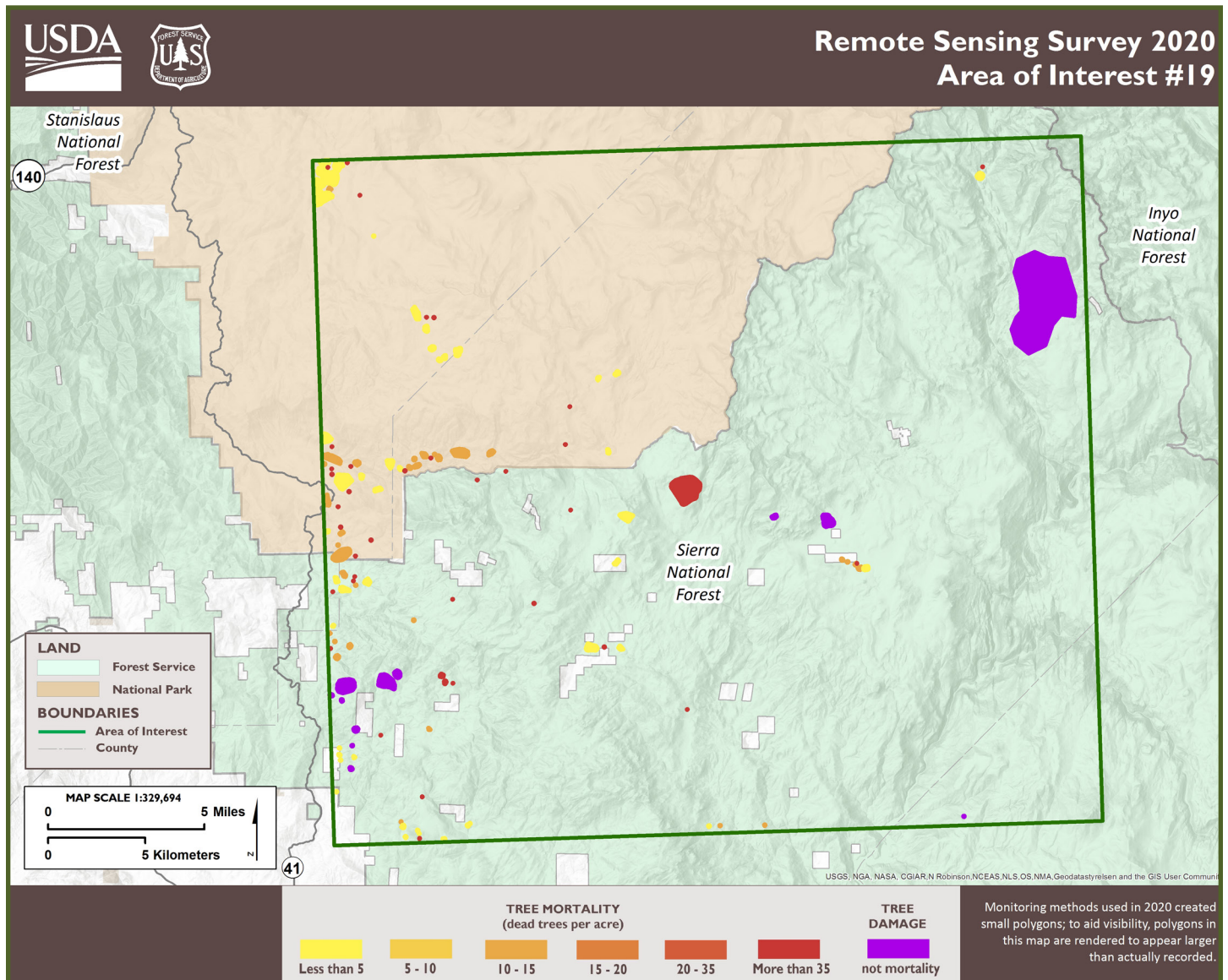


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	El Dorado Amador	300	decrease
White and red fir – fir engraver	El Dorado Amador	2,000	decrease

Remote sensing images in 2020 showed ongoing fir and pine mortality in many areas; however, mortality overall was significantly less in all tree species and especially reduced in white fir and ponderosa pine. Non-mortality damage was branch flagging in California red fir.

Results by AOI: 19

Land Ownership: private land, Sierra NF, Yosemite NP

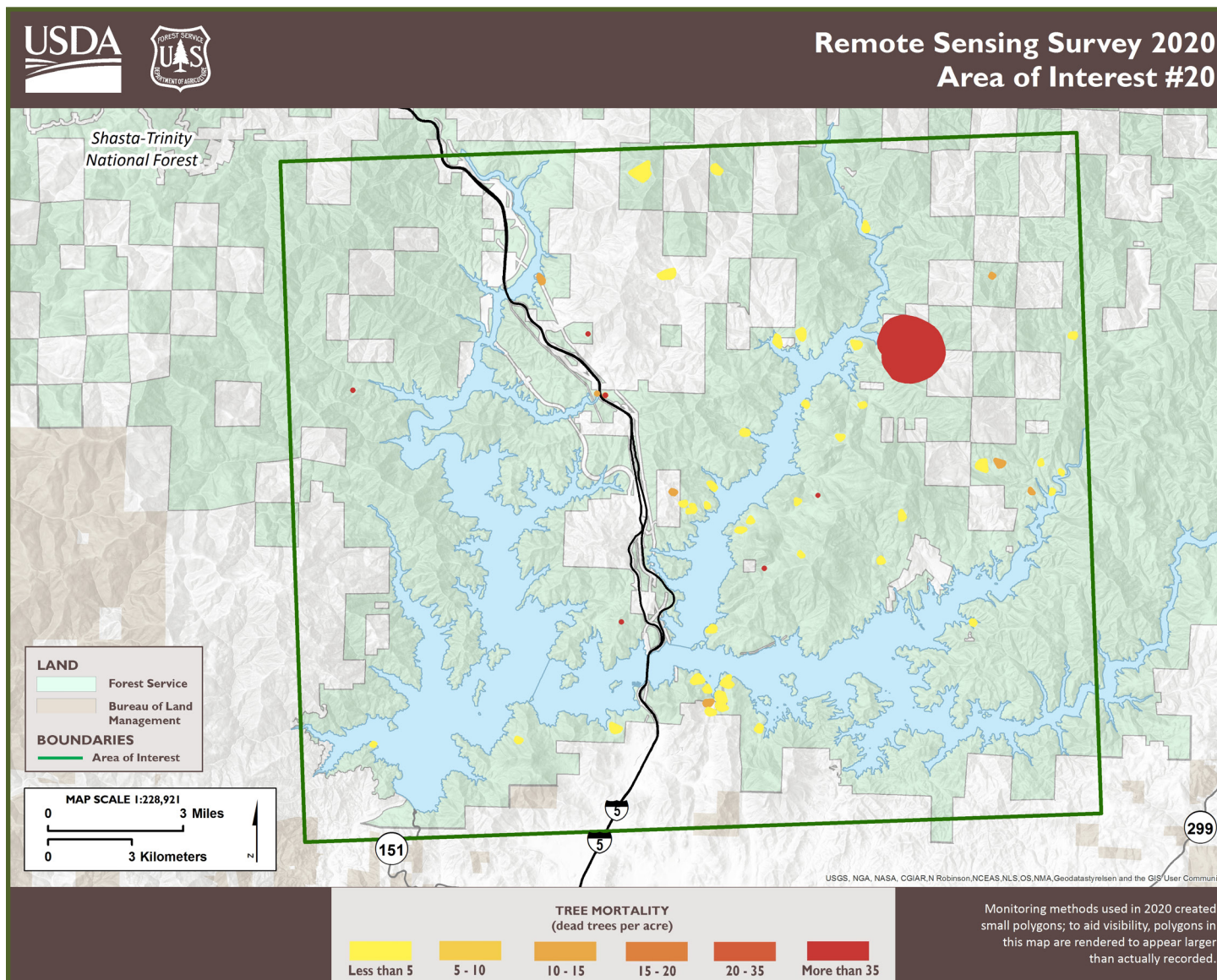


Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	Madera Mariposa Fresno Inyo	18,800	consistent
White and red fir – fir engraver	Madera Mariposa Fresno Inyo	2,000	decrease

Monitoring in 2020 detected considerable ongoing but reduced amounts of California red and white fir. Non-mortality damage was due to wildfire and affected all tree species. About 35% of this AOI was later affected by the 2020 Creek and Horse Fires after the damage shown in the map was recorded.

Results by AOI: 20

Land Ownership: BLM, private land, Shasta-Trinity NF



Host and Agent	County	2020 # of Trees, rounded to nearest 100 (estimate derived from acreage by % area affected metrics)	Increase or Decrease from 2019?
Yellow pine – pine beetle	Shasta	42,500	increase
White and red fir – fir engraver	Shasta	<100	decrease

2020 monitoring revealed ongoing pine mortality but was unable to discriminate between ponderosa and knobcone pine, so all pine mortality was attributed as ponderosa/yellow pine mortality. Yellow pine mortality greatly increased in 2020, particularly around recent wildfires.

Further Information about 2020 Remote Sensing:

Early in 2020, FHP staff tested several methods of remote sensing, including: manual delineation of tree mortality using visual interpretation of satellite and National Agriculture Imagery Program (NAIP) aerial imagery, machine learning techniques based on training datasets created from satellite imagery, and several automated change detection products that use satellite imagery. Manual delineation of mortality based initially on satellite and aerial imagery was selected because existing change detection methods seemed, from early-season evaluation, to be insufficiently detailed to detect mortality in diffuse, dispersed patterns typical of California forests, and automated machine learning methods were still too early in development. Additionally, recent satellite imagery at the <1m scale was readily available and could be used with existing ADS digital tools to enable single tree change detection and standardized recording.

The “scan and sketch” remote sensing method takes more surveyor hours than aerial survey flights; therefore, only a small percentage of California’s forestland could be surveyed this way with available capacity. Areas of Interest (AOIs) were selected to sample across the typical aerial survey area. Images were acquired in prioritized AOIs selected by forest health staff and key partners.

AOIs were selected using criteria for:

1. Extreme Drought Designation in the 2020 Drought Monitor: North Interior California (AOI 10, 20);
2. Recent severe Tree Mortality: Warner Mountains, Southern Sierras (AOI 6, 8, 14, 15, 18, 19); and
3. Pest or Pathogen of Interest: North Coast for Sudden Oak Death (*Phytophthora ramorum*) (9, 11-13, 16, 17), Southern California through Santa Cruz County for Goldspotted Oak Borer (*Agrilus auroguttatus*), Invasive Shot-hole Borers (1-5, 7).

High-resolution imagery came from two sources and was acquired between April 15 and October 22, 2020 (see map, page 4).

The team put in requests for satellite imagery including Geo-Eye-1 (0.4m pan-sharpened resolution), Worldview-2 (0.46m resolution), and Worldview-3 satellites (0.25m resolution) from Maxar Technologies and received most image coverage requested before the historic fire season of 2020 commenced. Other images that completed the AOIs were obtained later from NAIP orthophotos (0.6m spatial resolution) as they became available. This imagery covered the entire state but was mostly unavailable until late in the survey season.

The same input tools and software used for ADS were used for these monitoring efforts, allowing easy integration with the national ADS database as well as similar style of data entry and point/polygon creation. These tools included the Digital Mobile Sketch Mapping (DMSM) application for tablets and the Desktop Tools (DTT) extension for ArcMap software, both created by the Forest Health Assessment and Applied Sciences Team (FHAASST), USFS. The DMSM method was faster and proved easier to record polygons and polygon attributes than the Desktop Tools environment with current configurations. The provisional NAIP imagery was limited to the computer DTT environment, as its release date was after the reporting season and use of it in provisional format meant it could not be converted to the tile package (TPK) format necessary for compatibility with the DMSM methodology.

This “scan and sketch” effort required approximately 660 hours from 13 forest health specialists from the USFS and Cal Fire, all of whom were familiar with the AOI they surveyed but had limited ability to conduct ground checks in the field due to both covid-19 restrictions and the exceptional fire year.

It is also important to note that in several AOIs, later-season imagery may have provided better results. For example, Southern California imagery may have been too early to show much of the mortality that occurred during the summer months, and AOI 20 and the Warner Mountains initially yielded little apparent fir mortality compared to later-season NAIP imagery.

We also wanted to note that the following AOIs were impacted by fire, including by high severity fire, after monitoring was completed: AOI 19 (35% by Creek and Horse Fires); AOI 6 (15% by SQF Complex); AOI 5 (7% by Dolan Fire); AOI 14 (3% by W-5 Cold Springs Fire).

2020 methodologies were less conducive to detection, and therefore reported none or greatly reduced observations of:

- Incense cedar (*Calocedrus decurrens*), sugar pine (*Pinus lambertiana*), Coulter pine (*Pinus coulteri*), and bigcone Douglas-fir (*Pseudotsuga macrocarpa*) which were difficult to identify amongst mixed conifer stands dominated by fir and yellow pine
- Coastal pines like Monterey (*Pinus radiata*) and Bishop pine (*Pinus muricata*)
- Damage to trees that had very limited presence in the AOI areas, including Santa Lucia fir (*Abies bracteata*), Port-Orford cedar (*Chamaecyparis lawsoniana*), and quaking aspen (*Populus tremuloides*). AOIs did not cover bristlecone pine (*Pinus longaeva*) or other host ranges
- Damage affecting mostly small or understory trees, including tree damage caused by bears, although some was identified
- Non mortality damage such as branch flagging, defoliation etc.

Scan & Sketch Acknowledgements: Thank you to Cal Fire forest health staff Kim Corella and Chris Lee; USFS R5 forest health staff Beverly Bulaon, Charlie Barnes, Ashley Hawkins, Andrea Hefty, Stacy Hishinuma, and Nicholas Stevens; and contractors Loren MacAffee and Stephen McKelvey for their work in the scan and sketch effort. Thank you to David Greenberg, Jeff Kaiden, Jeff Moore, and Micha Salomon for the development of methods, protocols, and alternatives exploration used in this year's survey. Thank you to inter-Regional cooperation from USFS Regions 1 and 10, the USFS Washington Office, and Geospatial Technology and Applications Center (GTAC) and the newly formed USFS remote sensing work group for their support and expertise.