



Photo credit, Aly McAlexander, DFFM Forest Health Specialist

ARIZONA FOREST HEALTH CONDITIONS 2020

**A publication by the Forest Health Program of the Arizona
Department of Forestry and Fire Management**

Arizona has an incredibly diverse landscape. From the lower Sonoran desert scrub and pinyon-juniper woodland to the high elevation spruce-fir forests.

Forests cover approximately 27% of the state, which is over 19 million acres. These forests are comprised of 37 species of coniferous and hardwood trees. The majority of forestland is located above the Mogollon Rim. Juniper (*Juniperus* spp.) and pinyon juniper (*Pinus edulis-Juniperus* spp.) woodlands are the most abundant forest type in Arizona, occupying approximately 14.8 million acres, or 20.3% of the state. The rarest and most significant in ecological terms is riparian forest, which occupies less than one-half of 1% of Arizona's land.

In urban areas, we experience urban forests that are typically composed

**Over 17 million acres
surveyed by air**

**81,000 acres of bark
beetle-caused tree
mortality**

**15,000 acres of tree
damage from sap
feeders**

**13,000 acres of tree
damage from
defoliators**

of a mix of native and introduced tree species that require various management techniques. These urban forests are inhabited by nearly 90% of Arizona's residents and provide numerous environmental, economic and social benefits.

With such a broad diversity of forests comes a diverse group of insects and diseases; from native and non-native pine engraver beetles to introduced fungal pathogens such as white pine blister rust. This report includes information on the insects and diseases having significant impact on Arizona's forested landscapes. Annually, the Department of Forestry and Fire Management (DFFM) partners with the USDA Forest Service to survey millions of acres of forest and woodland resources from the air; this is called an Aerial Detection Survey (ADS). The ADS provides land managers and the public with information about landscape-level forest and woodland health conditions (Fig. 1). In the summer of 2020, the ADS covered over 17 million acres to identify dead and/or dying trees. Throughout the ADS season, and the rest of the year, USDA Forest Service, DFFM forest health specialists, and district staff verify ADS data by conducting ground surveys and providing landowners with technical assistance. This conditions report summarizes the 2020 ADS program and discusses current forest and woodland health issues in Arizona.

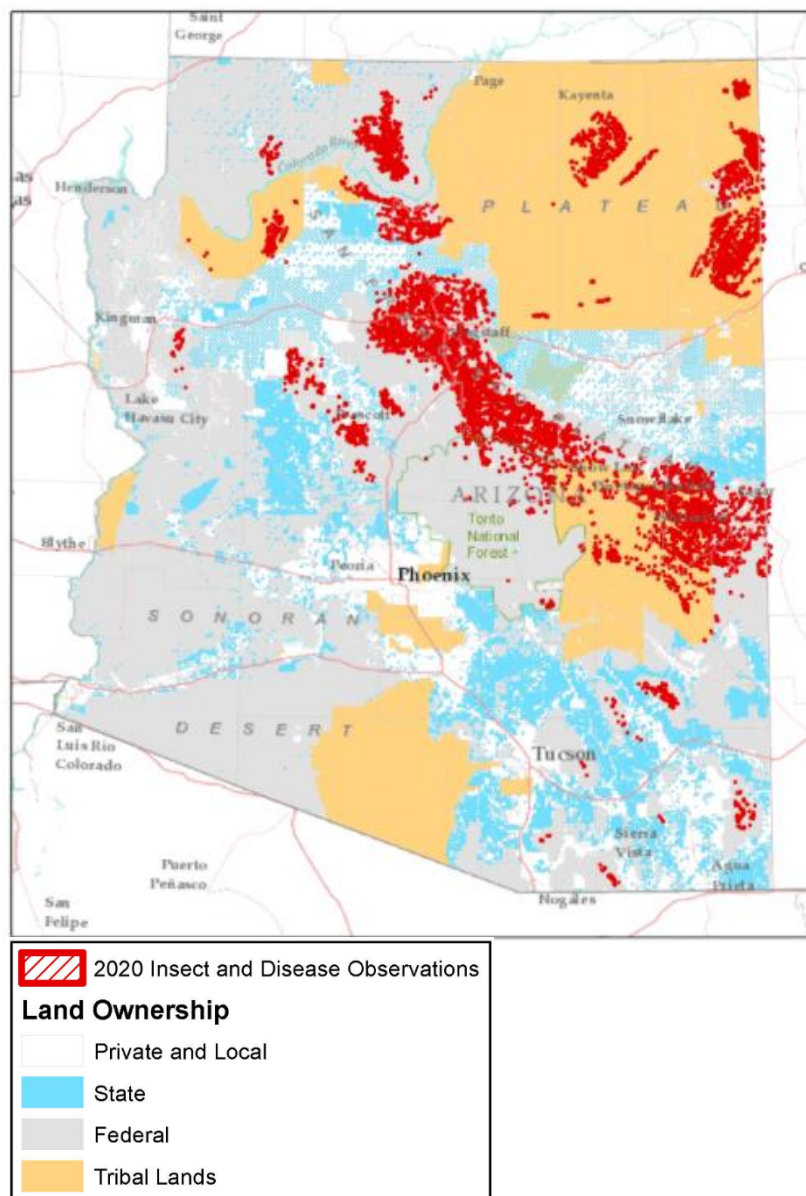


Figure 1. Arizona 2020 Aerial Detection Survey Insect and Disease Locations

Overview

The spring of 2020 experienced fairly good precipitation (Fig. 2), which led to an 82% decrease in total acres of bark beetle-caused tree mortality. The majority of bark beetle damage occurred in Ponderosa Pine forests on Federal lands. Although the spring precipitation helped decrease bark beetle damage for the summer of 2020, increases in damage caused by forest insect defoliators and sap feeding insects occurred. It is worth mentioning that although the 2020 spring precipitation was adequate, the summer hardly experienced any monsoonal moisture, which increased abiotic stress caused by drought. Along with this lack of monsoonal moisture, we are experiencing a La Niña winter (Fig. 2). The National Oceanic and Atmospheric Administration estimates a 95% chance La Niña will last through the winter and will be relatively strong; this means the southern United States will experience warm and dry winter conditions (<https://www.climate.gov/enso>). Due to this lack in monsoonal moisture and La Niña winter conditions, many forest health professionals have begun noticing increasing mortality from bark beetles in the fall and winter of 2020.

Overall, much of Arizona’s forest health conditions improved from the last several years, but due to the lack of monsoonal moisture and the La Niña winter conditions, Arizona will likely experience worsened forest health conditions in the 2021 ADS season.

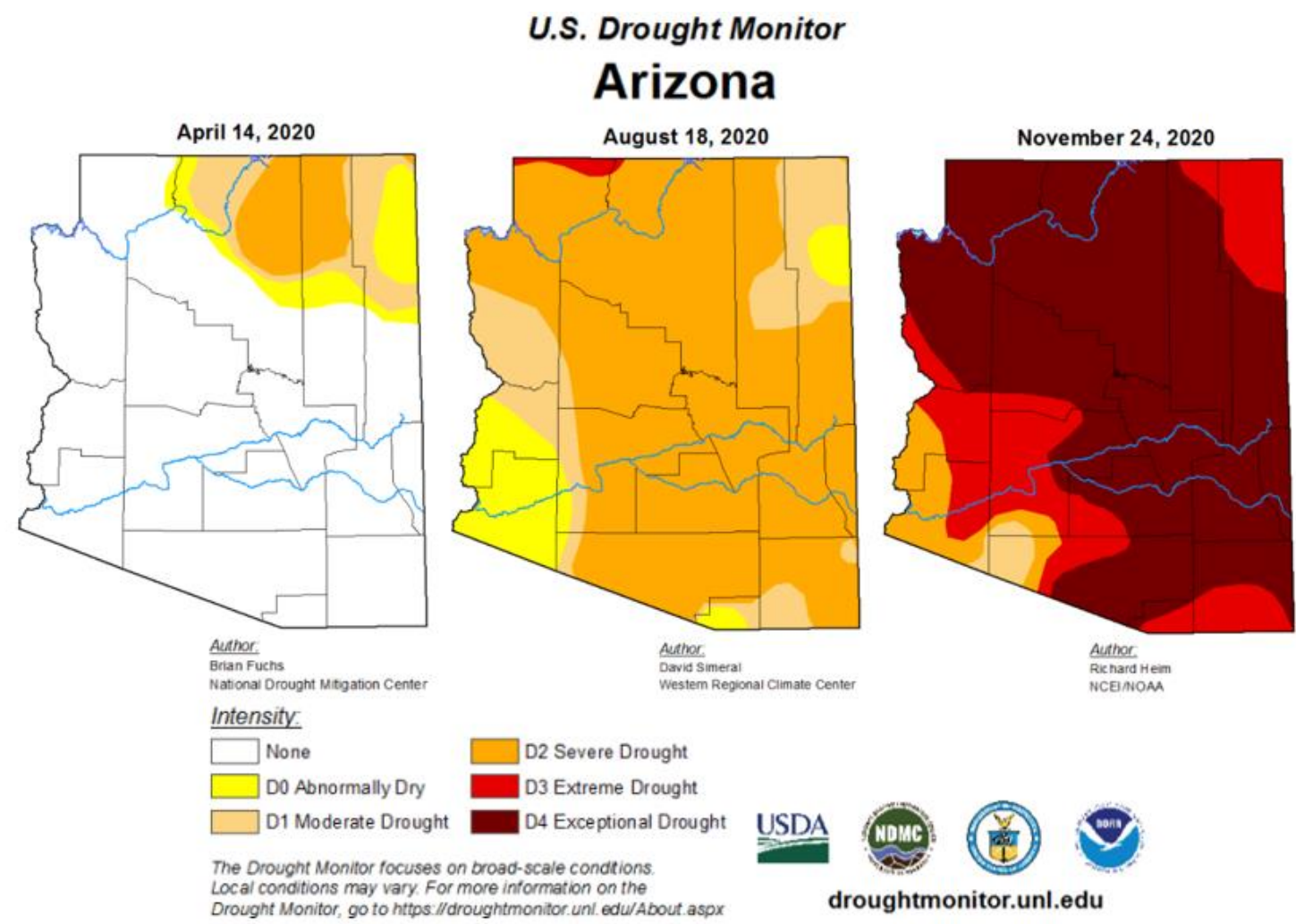


Figure 2. Drought Condition Comparisons for the Spring, Summer, and Fall of 2020

Arizona’s Five Districts

Arizona Department of Forestry and Fire Management has 5 distinct districts. Each district shares similar forest and woodland health issues while experiencing a varying degree of tree damage from insects and disease. Each district will be reviewed individually to more accurately show which insects and diseases are impacting the state, and where their populations can be found throughout the state.

It is worth noting that the acreages for each district may look inflated due to the fact that some acres are counted twice because more than one damage agent was found on those acres.

Northern District (A1S)

There was a total of 76,597.4 acres of forest land impacted by insects and disease in the Northern District in 2020. This is an 82% increase from 2019. Most of this increase is due to the increased abiotic damage (drought) that was reported on both state and federal lands, as well as increased bark beetle activity on federal lands. There was a very small increase in defoliation activity on federal lands, and all defoliation reported on private and tribal lands was new in 2020. Sap feeder activity also increased considerably on tribal lands, mostly caused by an increase in Pinyon Needle Scale (*Matsucoccus acalyptus*).

DCA Category (revised)	Federal	Private	State	Tribal Lands	Grand Total
Abiotic Agents**	10,997.3	9.2	2,467.5		13,474.0
Bark Beetles	51,070.1	1,595.1	687.6	39.2	53,392.1
Defoliators	5,814.8	41.0		199.0	6,054.8
Foliage and Shoot Diseases	1.3	15.7			17.0
Human Activities***	126.2	3.3			129.4
Sap Feeders	756.6	10.1		1,265.1	2,031.8
Unknown	1,424.5	62.3	9.5	2.0	1,498.4
Grand Total	70,190.9	1,736.7	3,164.6	1,505.3	76,597.4

Table 1. Northern District (A1S) 2020 Estimated Acres of Observed Tree Damage by Land Ownership

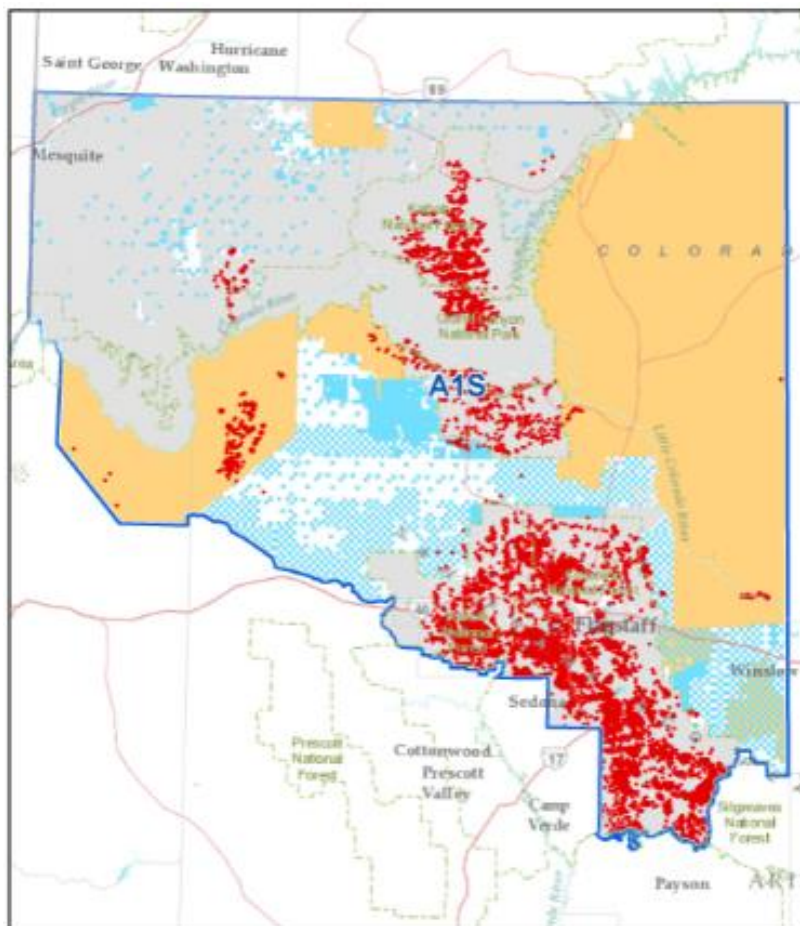
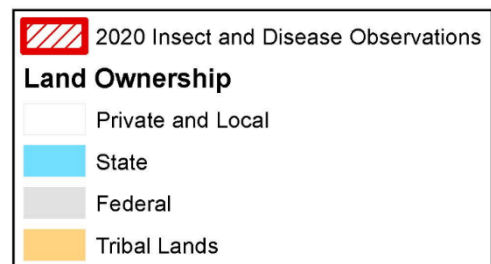


Figure 3. Location of Insect and Disease Activity in the Northern District (A1S)



Photo Credit: Daniel DePinte, Forest Health Specialist, USDA Forest Service (light levels of ponderosa pine mortality on the Kaibab NF)



Northeast District (A2S)

There was a total of 42,542.8 acres of forest land impacted by insects and disease in the Northeastern District in 2020. This is a 90% decrease from 2019. There was a considerable decrease in bark beetle activity among all four land ownerships. However, the largest decrease in bark beetle-caused tree mortality occurred on tribal lands, with a 95% decrease in bark beetle-damaged acres. Defoliating insect damage increased on Federal lands. A small portion of this defoliation was caused by Tamarisk leaf beetles (*Diorhabda* spp.), but unfortunately most of this new defoliation damage was caused by unknown causal agents.

DCA Category (revised)	Federal	Private	State	Tribal Lands	Grand Total
Abiotic Agents**	442.6			1,239.8	1,682.4
Bark Beetles	7,548.9	29.5	3.3	17,392.0	24,973.8
Defoliators	4,489.9	7.0		2,244.2	6,741.1
Foliage and Shoot Diseases	220.3			13.6	233.9
Sap Feeders	862.8	1.5		4,748.5	5,612.8
Unknown	159.5	12.3	10.4	3,116.7	3,298.9
Grand Total	13,723.9	50.3	13.8	28,754.9	42,542.8

Table 1. Northeast District Estimated Acres of Observed Tree Damage by Land Ownership (Acres)

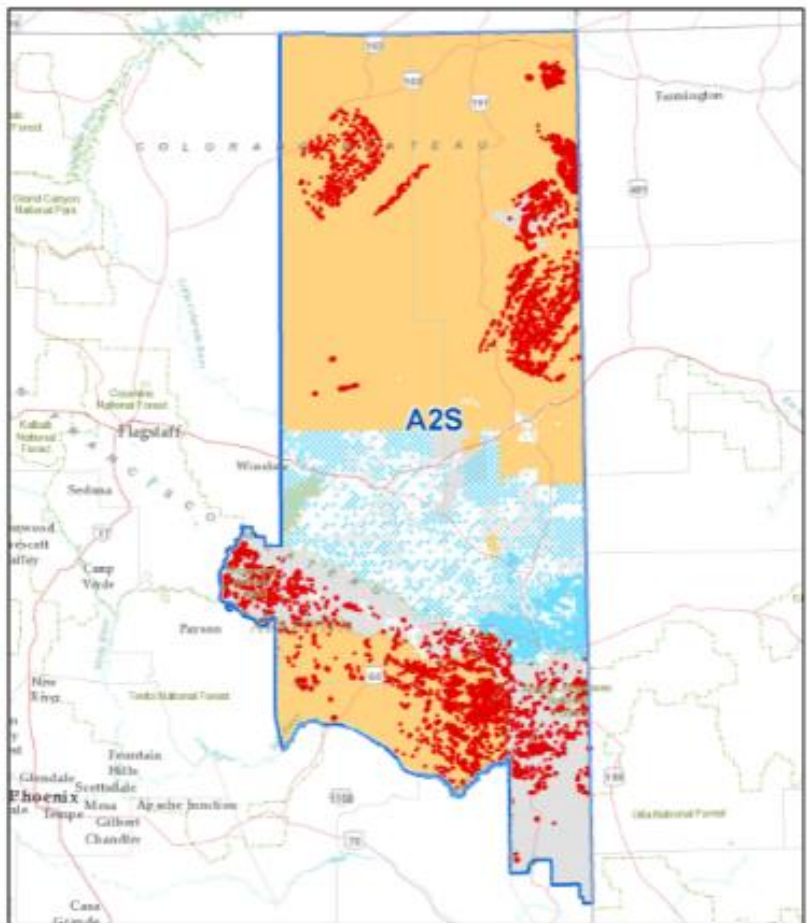


Photo Credit: Daniel DePinte, Forest Health Specialist, USDA Forest Service (light levels of ponderosa pine mortality on the Coconino NF)



Figure 4. Location of Insect and Disease Activity in the Northeast District (A2S).

Southeast District (A3S)

There was a total of 776.5 acres of forest land impacted by insects and disease in the Southeastern District in 2020. This was a 91% decrease in damage from 2019. Although the overall damage in this area decreased, there was an increase in defoliation of Arizona white, Mexican blue, Mexican gray, and Gambel oaks; the cause of this defoliation is unknown at this time. All other damage agents in this district saw a decrease in activity during the 2020 ADS season.

DCA Category (revised)	Federal	Private	State	Grand Total
Bark Beetles	657.5		0.3	657.8
Defoliators	85.2			85.2
Unknown	13.2	0.1	0.2	13.5
Wood Borers	19.9			19.9
Grand Total	776.0	0.1	0.4	776.5

Table 2. Southeast District Estimated Acres of Observed Tree Damage by Land Ownership (A3S)

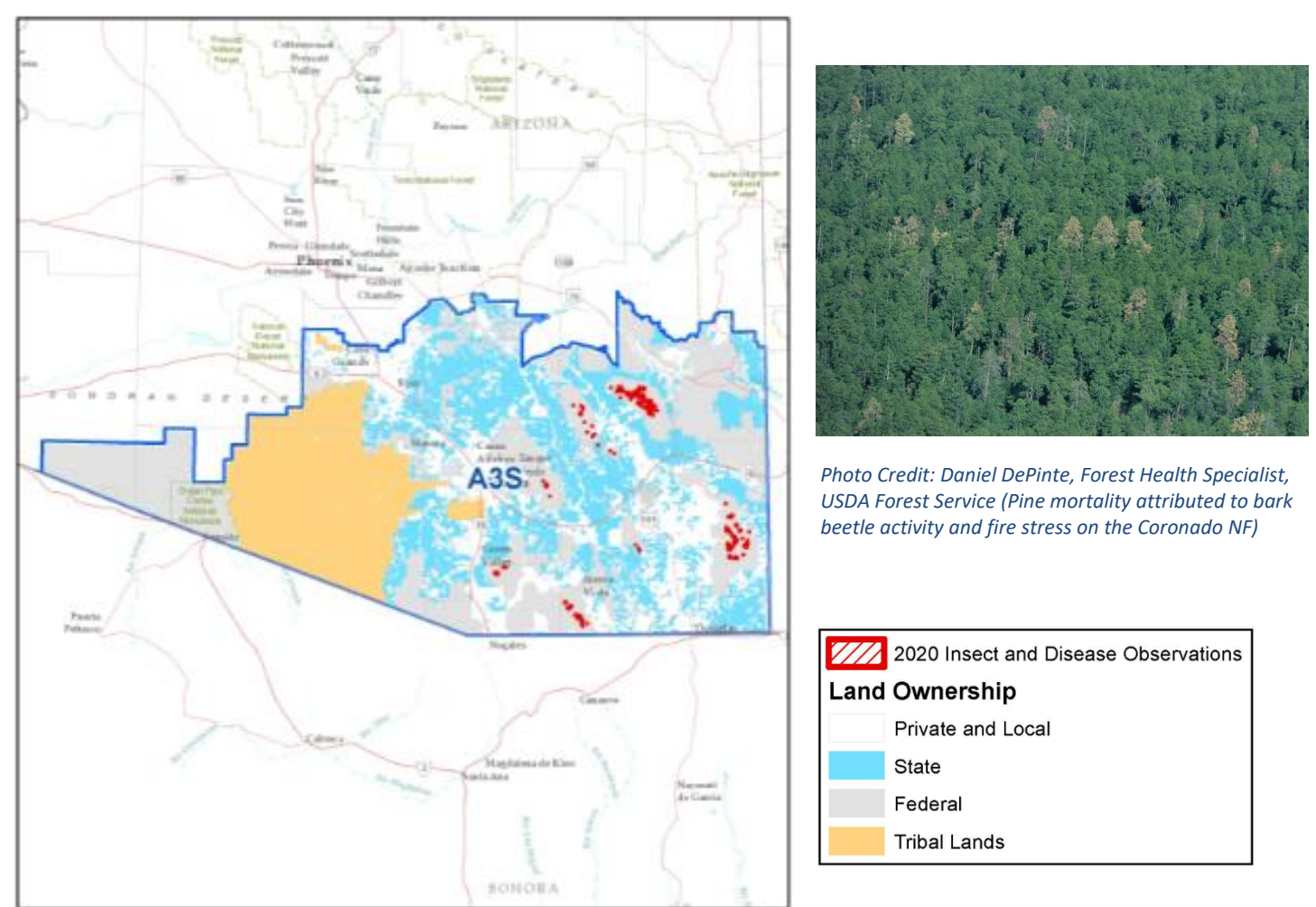


Figure 5. Location of Insect and Disease Activity in the Southeast District (A3S)

Central District (A4S)

There was a total of 4,589.2 acres of forest land impacted by insects and disease in the Central District in 2020. This is a 31% decrease in damage from 2019. This small decrease is mostly attributed to the decrease in bark beetle activity. Although overall bark beetle activity declined, there was an increase in bark beetle-caused tree mortality on tribal lands in this district. Sap feeder activity also increased considerably on all four land ownerships, mostly caused by an increase in Pinyon Needle Scale (*Matsucoccus acalyptus*) activity. There was also a small increase in abiotic damage (drought stress) on tribal lands.

DCA Category (revised)	Federal	Private	State	Tribal Lands	Grand Total
Abiotic Agents**				58.5	58.5
Bark Beetles	580.9	2.2		891.4	1,474.5
Defoliators	67.7			22.1	89.8
Sap Feeders	2,419.8	105.5	2.8	222.4	2,750.5
Unknown	135.8			80.1	215.9
Grand Total	3,204.2	107.7	2.8	1,274.5	4,589.2

Table 4. Central District Estimated Acres of Observed Tree Damage by Land Ownership (A4S)

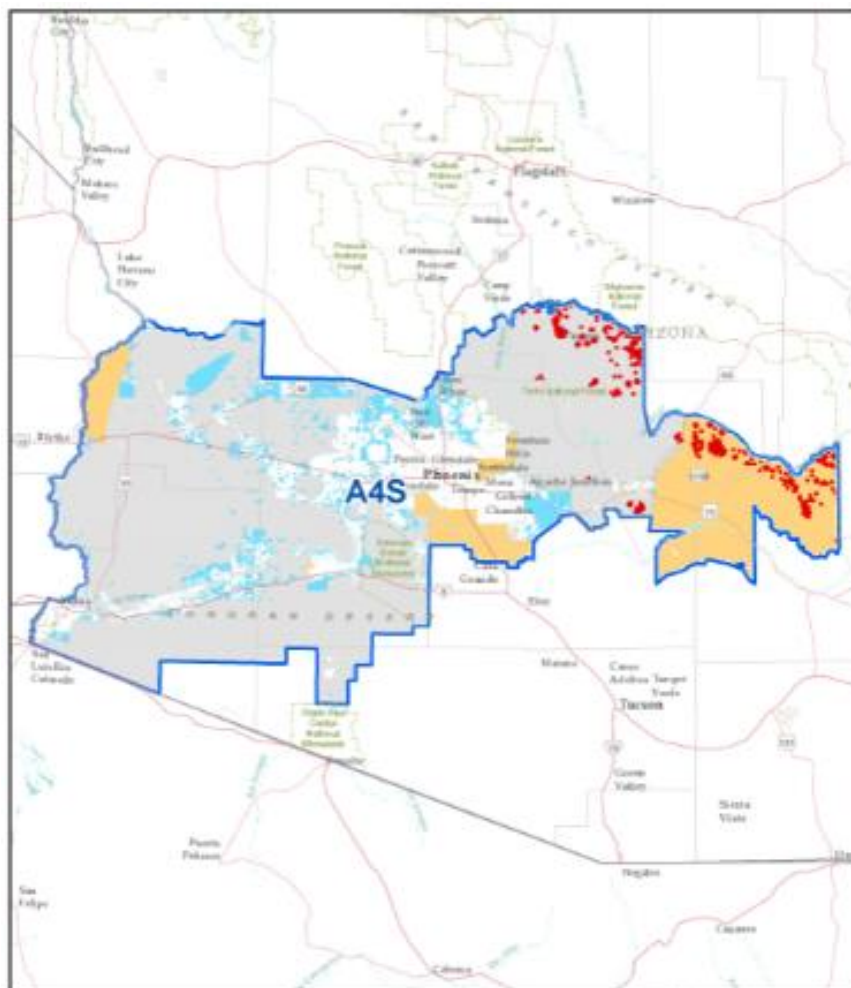
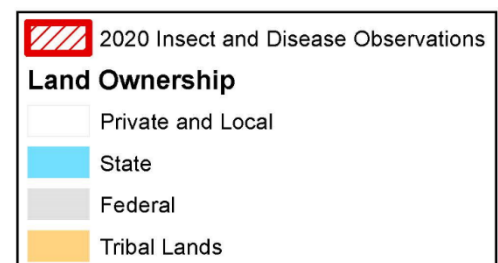


Figure 6. Location of Insect and Disease Activity in the Central District (A4S)



Photo Credit: Daniel DePinte, Forest Health Specialist, USDA Forest Service (very light ponderosa pine mortality attributed to bark beetle activity on the Tonto NF)



Northwest District (A5S)

There was a total of 5,665.2 acres of forest land impacted by insects and disease in the Northeast district in 2020. This is a considerable increase in acreage compared to 2019 (618% increase). This increase was mostly caused by Pinyon Needle Scale (*Matsucoccus acalyptus*) activity on federal and private lands. Insect defoliation increased slightly since 2019, with a small portion of this damage being caused by Pine sawflies (*Neodiprion* spp., *Zadiprion* spp.) and several other unknown defoliating causal agents. Bark beetle activity slightly increased in 2020, with most of that activity occurring on federal lands.

DCA Category (revised)	County	Federal	Private	State	Grand Total
Bark Beetles	2.3	511.2	12.4	6.4	532.3
Defoliators		70.3	325.9		396.2
Sap Feeders		3,609.0	973.8	103.3	4,686.1
Unknown		7.6	43.0		50.6
Grand Total	2.3	4,198.1	1,355.2	109.7	5,665.2

Table 3. Northwest District Estimated Acres of Observed Tree Damage by Land Ownership (A5S)

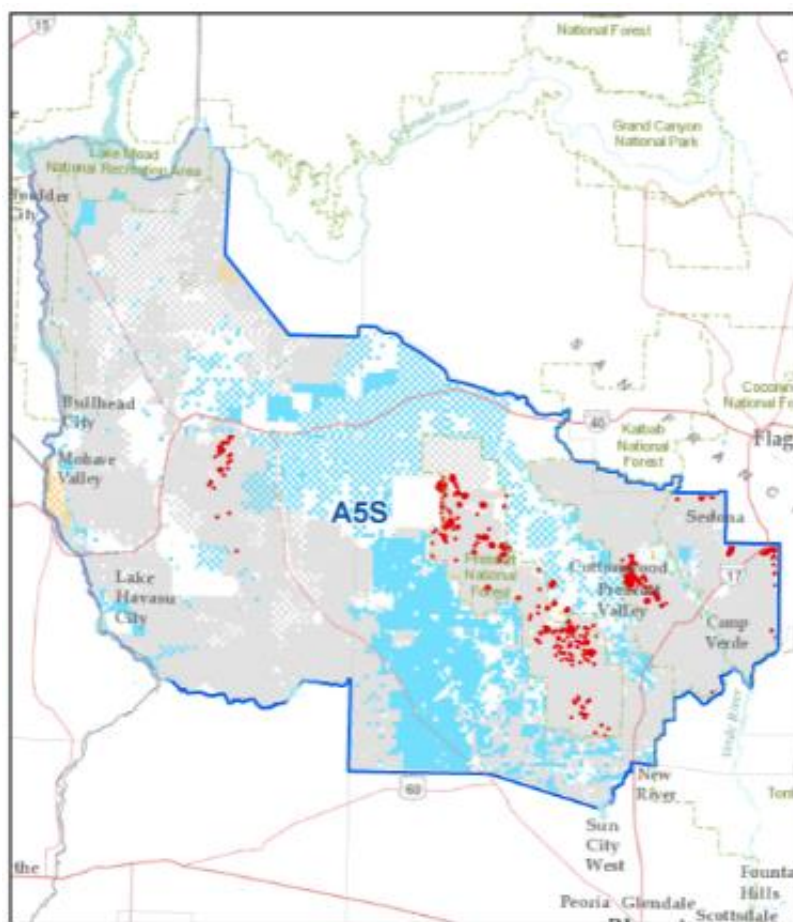
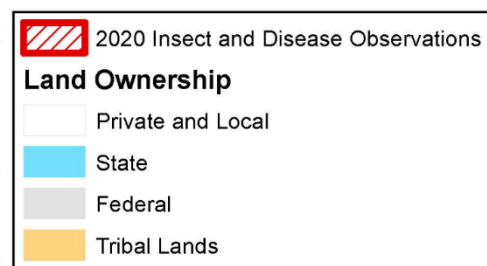


Figure 7. Location of Insect and Disease Activity in the Northwest District (A5S)



Photo Credit: Daniel DePinte, Forest Health Specialist, USDA Forest Service (Pinyon with thin crowns observed on the Prescott NF)



Flight Information

This year 17,035,691.1 acres were surveyed during the aerial detection survey season (Fig. 11). Nearly half of these acres were federal lands, a third were tribal lands, and the rest of the surveyed area was split between private and state lands (Table 6). Of the over 17 million acres flown, over 75% was Forest lands, over 20% were Pinyon-Juniper woodlands, and 3% was other woodland (composed of aspen and other high elevation hardwoods) (Table 7).

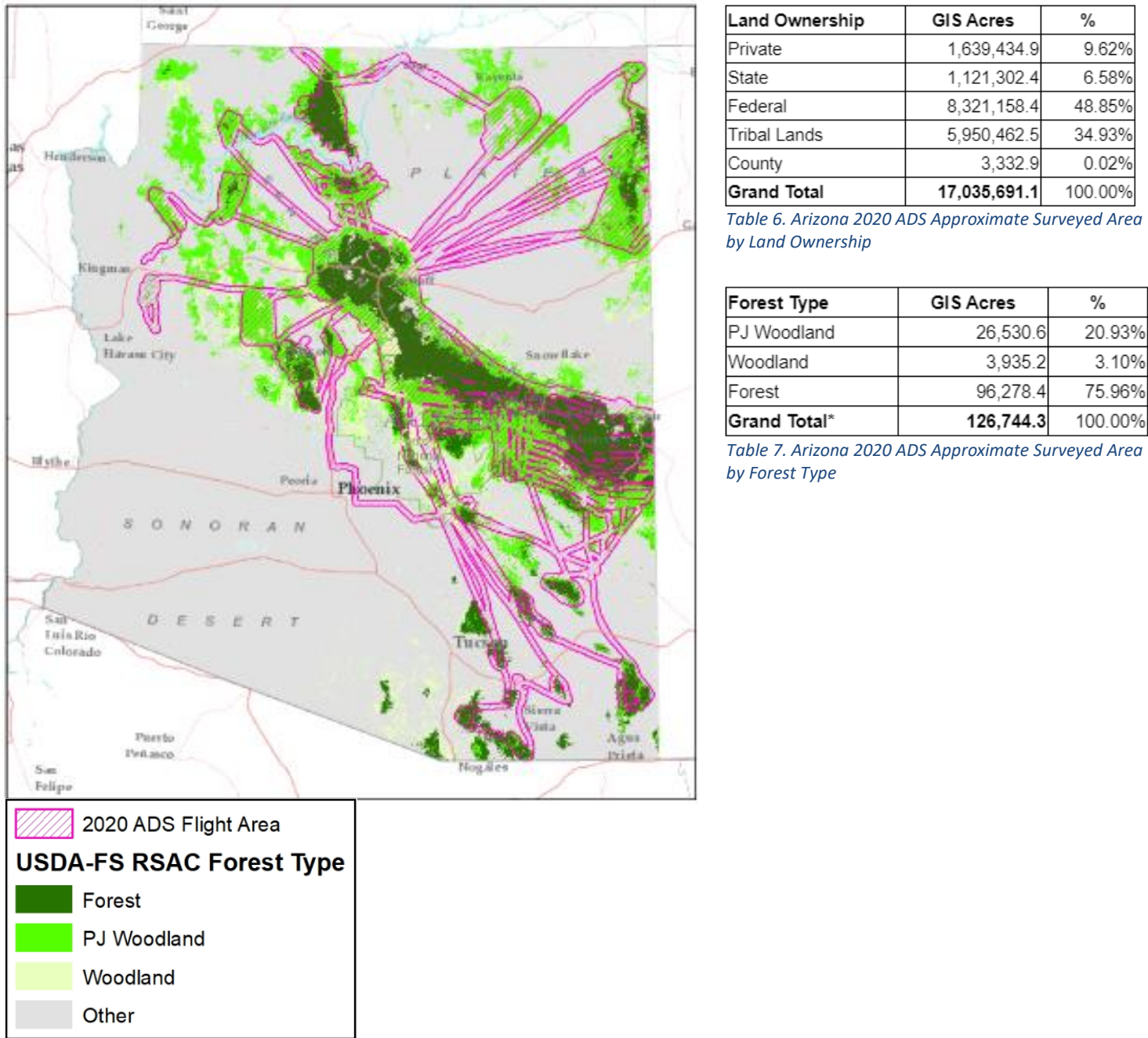


Figure 11. 2020 Aerial Detection Survey Flight Area by forest type

Statewide Insect and Disease Update

Bark Beetles

In Arizona, there are multiple bark beetle species that can contribute to and/or cause tree mortality. The species that attack ponderosa pine in Arizona include: the pine engraver beetle (*Ips pini*), five spine ips (*Ips leconteii*), six spine ips (*Ips calligraphus*), western pine beetles (*Dendroctonus barberi*), mountain pine beetles (*Dendroctonus ponderosae*), roundheaded pine beetles (*Dendroctonus adjunctus*), southern pine beetles (*Dendroctonus frontalis*), Mexican pine beetles (*Dendroctonus mexicanus*), and the red turpentine beetle (*Dendroctonus valens*). The pinyon ips (*Ips confusus*) is also found in Arizona where it attacks pinyon pines. Spruce beetles (*Dendroctonus rufipennis*), which attack englemann and blue spruce, are found in Arizona's forests as well. The Douglas-fir beetle (*Dendroctonus pseudotsugae*), as its name suggests, attacks Douglas-fir. The western balsam bark beetle (*Dryocoetes confusus*) attacks subalpine fir; the fir engraver (*Scolytus ventralis*) attacks true firs; and the cedar bark beetle (*Phloeosinus* spp.) attacks junipers and Arizona cypress. Overall, there are 15 different species of bark beetles found throughout Arizona and, for the purposes of this report, are all grouped together.

A healthy tree has natural chemical and physical defense systems against bark beetles. The creation and flow of resin is a physical defense. Some trees even create resin with toxic compounds that can kill beetles, which is a chemical defense. However, when a tree is stressed (from drought, disease, abiotic damage, or even wildfire) their defense mechanisms become impaired, and the tree becomes more vulnerable to beetle attacks.

Although bark beetle activity decreased throughout the state, a few individual districts saw some increases in acres of bark beetle-caused tree mortality. With the severe drought conditions Arizona is currently experiencing (Fig.2), and with the unfortunate outlook from the La Niña winter, Arizona's forests will be under severe drought stress, thereby making them more susceptible to bark beetle infestation in 2021. Although the outlook from this year's ADS findings look optimistic due to the decrease in overall tree mortality, it is worth discussing the possibility that Arizona's current severe drought status, along with the La Niña winter, could mean an increase in bark beetle-caused tree mortality in 2021.



Photo Credit: Daniel DePinte, Forest Health Specialist, USDA Forest Service (Spruce mortality attributed to spruce beetle activity observed in the Mt. Baldy Wilderness, 2020)

Forest Health in Urban Areas

Aleppo pine blight is a recurring but intermittent issue in the southwest. Over the last few years, the Phoenix Metropolitan area has experienced minimal activity from this damage agent. However, during the fall of 2020 an increase in Aleppo Pine blight activity was seen due to the severe drought conditions the state is experiencing.

While there has been much speculation, no definitive cause has been identified. In an effort to identify the causal agent behind the blight, monitoring efforts were conducted by DFFM staff in December 2018, January 2019, April 2020, and December 2020. All of these monitoring efforts occur at the same 4 locations throughout the Phoenix Metropolitan area. These locations were picked because they are areas where the blight had previously been observed or was currently being observed. Trees were inventoried taking into consideration species and DBH, and were photographed and rated based on the degree of blight impacting the crown. Additionally, needle samples were removed using an extendable pole pruner and examined for mites. The trees are examined for mites because in 2018, several trees with severe signs and symptoms of blight had the pine feeding mite (*Oligonychus milleri*) present at varying levels. There were other instances where trees were not showing signs of blight, but were also infested with mites. Therefore, at this time, part of our monitoring efforts for Aleppo Pine Blight include looking for *O. milleri* with the possibility of discovering a connection between the blight and the mite.

The Mediterranean pine engraver (*Orthotomicus erosus*), or MPE, was first discovered in the Central Valley of California in 2004. This non-native bark beetle has steadily spread to other regions in the southwest. In 2018, monitoring traps (Fig. 9) were established in the Phoenix metropolitan area to determine if MPE was present. When the program began, 16 traps were placed around the Phoenix Metro



Figure 9. Photo credit, Aly McAlexander, DFFM Forest Health Specialist (Lindgren funnel trap used for MPE monitoring, Rotary Park in Scottsdale, AZ, 2020)

area for a period of 20 weeks in the summer. In 2020 a total of 30 traps were placed throughout the Phoenix Metro area and monitored for 20 weeks throughout the summer. In order to determine if the beetles' lifecycle is different in Arizona's warm climate (i.e. if the beetles are actively flying and reproducing during the relatively mild fall and winter), 5 of the 30 traps were left in place after the summer trapping season ended. Trap samples are collected every week, frozen, and later processed and counted (Fig. 10). Since monitoring began in 2018, over 131,000 MPE beetles have been collected from the Phoenix Metropolitan area.



2019

2020

Figure 8. Photo credit, Aly McAlexander, DFFM Forest Health Specialist (Comparison photos of an Aleppo Pine suffering from Aleppo Pine Blight in 2019 and nearly recovered by 2020)

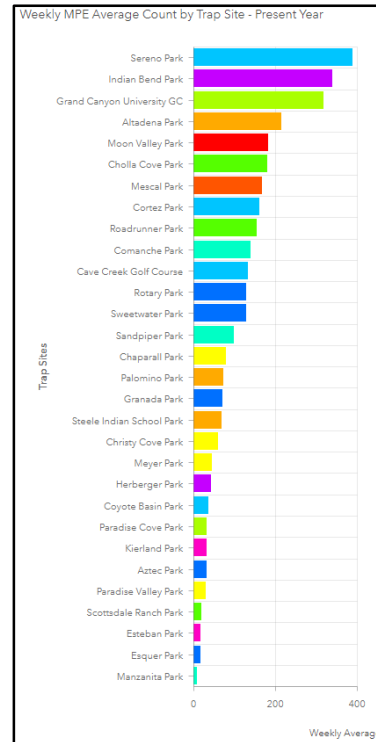


Figure 10. Graph of DFFM's current average MPE count by trap site (All 30 trap sites listed are the 2020 trap site locations, and all data recorded in this graph is from 2018 to current)

Contact Information

The DFFM Forest Health Program is a statewide program that is based in Phoenix, AZ.

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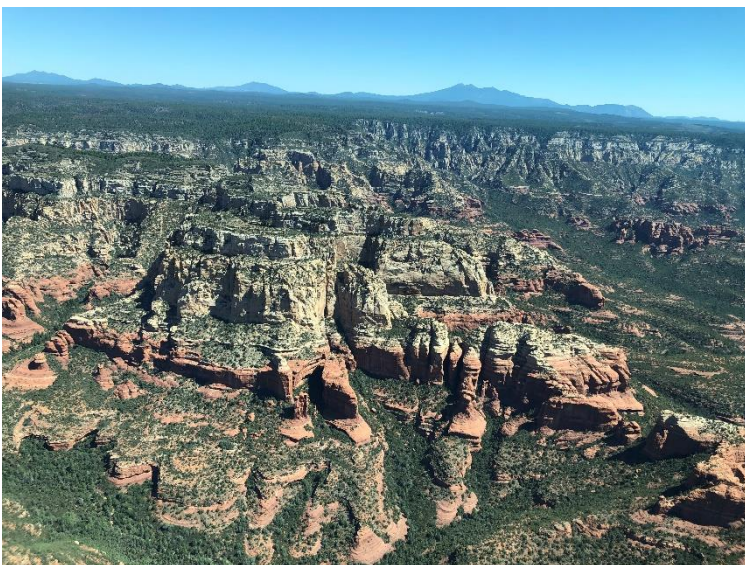


Photo Credit: Aly McAlexander, DFFM Forest Health Specialist



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