



April 2020

WILDFIRE

Information on Forest Service Response, Key Concerns, and Effects of the Chetco Bar Fire

GAO Highlights

Highlights of [GAO-20-424](#), a report to congressional requesters

Why GAO Did This Study

A wildfire known as the Chetco Bar Fire began in the summer of 2017 in southwest Oregon and burned more than 190,000 acres over nearly 4 months. Since the fire began in a national forest, the Department of Agriculture's Forest Service played a key role in managing the firefighting response. Because the fire also threatened other lands, state and private firefighting entities were also involved.

GAO was asked to review the Forest Service's response to and the effects of the Chetco Bar Fire. This report describes (1) key events of the Chetco Bar Fire and the Forest Service's firefighting response, (2) key concerns raised by Forest Service officials and stakeholders about the Forest Service's response, and (3) effects of the fire on local communities and resources.

GAO reviewed federal documents related to key events and the response, such as incident action plans and daily status summaries; analyzed reports on effects of the fire; and visited burned areas. GAO also interviewed Forest Service, state, and local officials involved in the response, as well as other stakeholders—such as representatives of nongovernmental organizations and community members—to discuss key concerns and effects of the fire. To identify the stakeholders, GAO reviewed documents and interviewed Forest Service officials and stakeholders, who suggested others to interview.

View [GAO-20-424](#). For more information, contact Anne-Marie Fennell at (202) 512-3841 or fennella@gao.gov.

April 2020

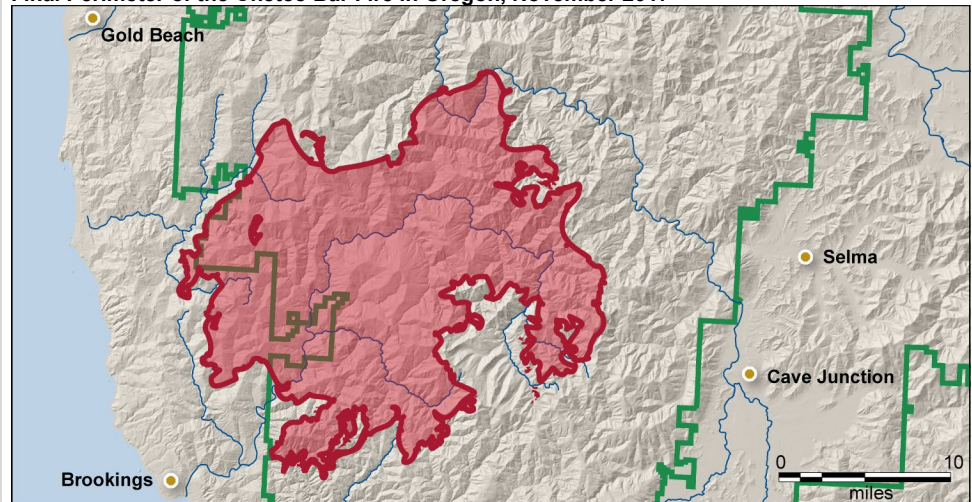
WILDFIRE

Information on Forest Service Response, Key Concerns, and Effects of the Chetco Bar Fire

What GAO Found

The Chetco Bar Fire was first reported in July 2017, burning in the Rogue River-Siskiyou National Forest in Oregon. Because of the remote, steep terrain, initial Forest Service attempts to fight the fire at close range were unsuccessful. The fire grew slowly over the next month. Firefighters, directed by the Forest Service, responded in various ways, such as by constructing "firelines"—clearing vegetation—in an effort to stop the fire's spread. In mid-August, strong, hot winds caused the fire to expand rapidly, from 8,500 acres to more than 90,000 acres over several days, threatening thousands of homes. Firefighters continued constructing firelines and dropped water and retardant on the fire to try to contain it. In September, the weather changed and cooler days and rain moderated the fire. Firefighters fully contained the fire in November (see figure).

Final Perimeter of the Chetco Bar Fire in Oregon, November 2017



Final Chetco Bar Fire perimeter (approximate) Rogue River-Siskiyou National Forest boundary

Source: GAO analysis of U.S. Forest Service information; U.S. Forest Service (map). | GAO-20-424

Forest Service officials and stakeholders raised a number of key concerns about the Forest Service's response to the Chetco Bar Fire. For example, some said that if the Forest Service's response had been more aggressive, it might have kept the fire from growing and threatening homes. Forest Service officials said that in making firefighting decisions, they prioritized firefighter safety and considered the likelihood that a particular response would be successful. The agency has taken steps to improve decision-making for future wildfires, such as developing a tradeoff analysis tool to help decision makers assess firefighting options.

Forest Service officials, stakeholders, and documents identified various effects of the fire. Some of these sources cited negative effects including destruction of six homes, damage to roads and trails, and damage to habitat for the northern spotted owl. However, the fire likely improved habitat for some species, such as woodpeckers that eat beetles that feed on burned trees, according to officials.

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Abbreviations

BLM	Bureau of Land Management
BAER	Burned Area Emergency Response
NIMO	National Incident Management Organization

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April 29, 2020

The Honorable Peter DeFazio
Chairman
Committee on Transportation and Infrastructure
House of Representatives

The Honorable Greg Walden
Republican Leader
Committee on Energy and Commerce
House of Representatives

A wildfire known as the Chetco Bar Fire began in the summer of 2017 in southwest Oregon and burned for several months before it was declared contained in November of that year. The fire, which started in the Rogue River-Siskiyou National Forest, was first reported on July 12, at which point it was estimated to be between one quarter and one half acre in size. The Chetco Bar Fire grew slowly in its initial weeks and then spread quickly the next month, threatening communities such as Brookings, Oregon. The fire burned over 190,000 acres and, according to the Department of Agriculture's Forest Service and Department of the Interior's Bureau of Land Management (BLM), cost an estimated \$58 million in federal funds to suppress.¹

Since the Chetco Bar Fire began in a national forest, the Forest Service played a key role in managing the firefighting response. Because the fire also threatened and burned BLM and private lands, other firefighting entities entered into "unified command" with the Forest Service and therefore were involved in deciding how to respond to the fire. In particular, the Oregon Office of the State Fire Marshal and Coos Forest

¹State and local agencies also spent funds to respond to the Chetco Bar Fire. For example, an official with the Oregon Office of the State Fire Marshal estimated the agency spent approximately \$6.9 million.

Protective Association were in unified command with the Forest Service for about a month over the course of the fire.²

During and after the Chetco Bar Fire, local officials, community members, and other stakeholders raised concerns about whether the Forest Service could have done more to suppress the fire. Questions have also been raised about effects the fire may have had on local communities and resources.

You asked us to review the Forest Service's response to and the effects of the Chetco Bar Fire. This report describes (1) key events in the Chetco Bar Fire and the Forest Service's firefighting response, (2) key concerns raised by Forest Service officials and stakeholders about the Forest Service's response to the Chetco Bar Fire, and (3) effects of the Chetco Bar Fire on local communities and resources.

To describe key events in the Chetco Bar Fire and the Forest Service's firefighting response, we reviewed documents from federal agencies, including executive summaries and transition plans from the various incident management teams, long-term assessments of the fire, daily incident status summaries, incident action plans, and transcripts of radio transmissions. We reviewed information on firefighting assets (for example, personnel, aircraft, and equipment) from daily incident status summaries, dispatch records, and documents on orders placed for firefighting assets. This information was generated by the Resource Ordering and Status System, an interagency computer software system that automates the asset ordering and dispatching process. To determine the reliability of the information from this system and other sources, we reviewed agency documents and interviewed agency officials and determined that the information was sufficiently reliable for the purpose of

²The Coos Forest Protective Association is a private, nonprofit corporation that provides fire protection on private lands, as well as on other lands under agreements with the Oregon Department of Forestry. In western Oregon, BLM has an agreement with the Oregon Department of Forestry and two nonprofit fire protection associations to provide fire management services, including fire suppression on BLM-administered lands. Accordingly, the Coos Forest Protective Association represented BLM's interest during the Chetco Bar Fire and was in unified command with the Forest Service for about 5 weeks. The Oregon Office of the State Fire Marshal has as its mission protecting citizens, their property, and the environment from fire and hazardous materials. It was in unified command with the Forest Service for about 3 weeks.

describing assets used to fight the Chetco Bar Fire.³ We also reviewed federal policies and guidance related to firefighting, including 2017 interagency standards for fire (known as the Red Book) and the Forest Service Chief's letter of intent for wildland fire, which provided direction to the agency for the 2017 fire season.⁴

In addition, we interviewed federal, state, and local officials who were directly involved in the firefighting response. Specifically, we interviewed members of incident management teams and other Forest Service staff assigned to the Chetco Bar Fire, and senior officials from BLM and nonfederal agencies that entered into unified command with the Forest Service, including the Oregon Office of the State Fire Marshal and Coos Forest Protective Association. We refer to all entities involved in responding to the fire as cooperators. We also interviewed Forest Service officials from headquarters, the Pacific Northwest Region, and the Rogue River-Siskiyou National Forest. To gain a better understanding of the Chetco Bar Fire's location and the geographic features of the area, in April 2019 we flew over the ignition point of the fire and key areas to which the fire spread, and in June 2019 we visited burned areas on the ground. We were accompanied by officials from the Rogue River-Siskiyou National Forest during our visits. In describing the Chetco Bar Fire, we divided the fire into phases to reflect changes in fire size and behavior, the risk to structures and resources, and the nature of the response.

To describe key concerns raised by Forest Service officials and stakeholders about the Forest Service's response to the Chetco Bar Fire, we reviewed agency documents and other documents on aspects of the response. We also interviewed Forest Service officials and stakeholders—including cooperators, other state and local officials, representatives of nongovernmental organizations, and community members affected by the Chetco Bar Fire—to discuss key concerns that arose from the response. We identified stakeholders through a review of agency documents and interviews with agency officials, and we asked those stakeholders to suggest others. We held a combination of 34 individual interviews and group discussions with 60 Forest Service

³In some cases, the information reported may underestimate the actual assets assigned to the fire, according to Forest Service officials.

⁴Department of the Interior and Department of Agriculture, National Interagency Fire Center, *Interagency Standards for Fire and Fire Aviation Operations* (Boise, ID: January 2017); Forest Service, *Chief's Letter of Intent for Wildland Fire – 2017* (Washington, D.C.: Mar. 20, 2017).

officials and a combination of 24 individual interviews and group discussions with 65 stakeholders.⁵ We analyzed the concerns raised and grouped them into categories. One GAO analyst conducted the initial categorization, and a team of analysts reviewed the categories and came to agreement on the categorization. Because this was a nonprobability sample, the views of agency officials and stakeholders are not representative of all views but provide illustrative examples of the types of concerns raised about the response to the Chetco Bar Fire. We did not assess the compliance of individual firefighters or agency officials with applicable firefighting guidance, in part because responding to wildfire requires considerable professional judgment.⁶

To describe the effects of the Chetco Bar Fire on local communities and resources, we reviewed reports and other documents related to the effects of the fire. In particular, we reviewed one report prepared for the city of Brookings on the effects of the Chetco Bar Fire on the city and two reports on the effects of the 2017 fire season in Oregon in general.⁷ We interviewed the authors of these reports to discuss their methodologies, their sources of data, and any limitations on their methodologies and reported data, and we determined the reports to be reasonable for our purposes.⁸ Other information we reviewed included post-fire damage assessments and documents regarding air quality during the fire. In addition, we discussed the effects of the Chetco Bar Fire during our interviews with agency officials and stakeholders. To gain a better understanding of the fire's effects on the ground, in June 2019 we visited several locations affected by the fire. We grouped the effects identified

⁵To quantify the number of agency officials and stakeholders, we use the following modifiers throughout the report: "some" represents two to three agency officials or stakeholders, "several" represents four to six, and "many" represents seven or more. We considered each interview or group discussion as a unit of one, regardless of how many individuals participated.

⁶According to *Interagency Standards for Fire and Fire Aviation Operations*, "fire operations doctrine does not consist of procedures to be applied to specific situations so much as it sets forth general guidance that requires judgment in application." Department of the Interior and Department of Agriculture, National Interagency Fire Center, *Interagency Standards for Fire and Fire Aviation Operations*.

⁷ECONorthwest, *Chetco Bar Fire: Economic Impacts and Opportunities* (Portland, OR: October 2018); Oregon Forest Resources Institute, *Impacts of Oregon's 2017 Wildfire Season* (Portland, OR: Jan. 2, 2018); Oregon Tourism Commission, *The Impacts of the 2017 Wildfires on Oregon's Travel and Tourism Industry* (Portland, OR: July 16, 2018).

⁸These reports had some limitations, such as small sample sizes and limited data, but were reasonable to use for descriptive purposes.

into categories. One analyst conducted the initial categorization, and a team of analysts, including an economist, reviewed the categories and came to agreement on them. To help determine whether we captured the main effects of the Chetco Bar Fire in these categories, we compared our categories of effects identified with two reports on the general effects of wildfire.⁹ We did not include some identified effects because they were of relatively small magnitude or we lacked sufficient data to reliably report on them. Examples of effects we excluded were local government costs for fire suppression and emergency response, and possible effects on local tax revenue and insurance premiums.

We conducted this performance audit from March 2019 to April 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Rogue River-Siskiyou National Forest

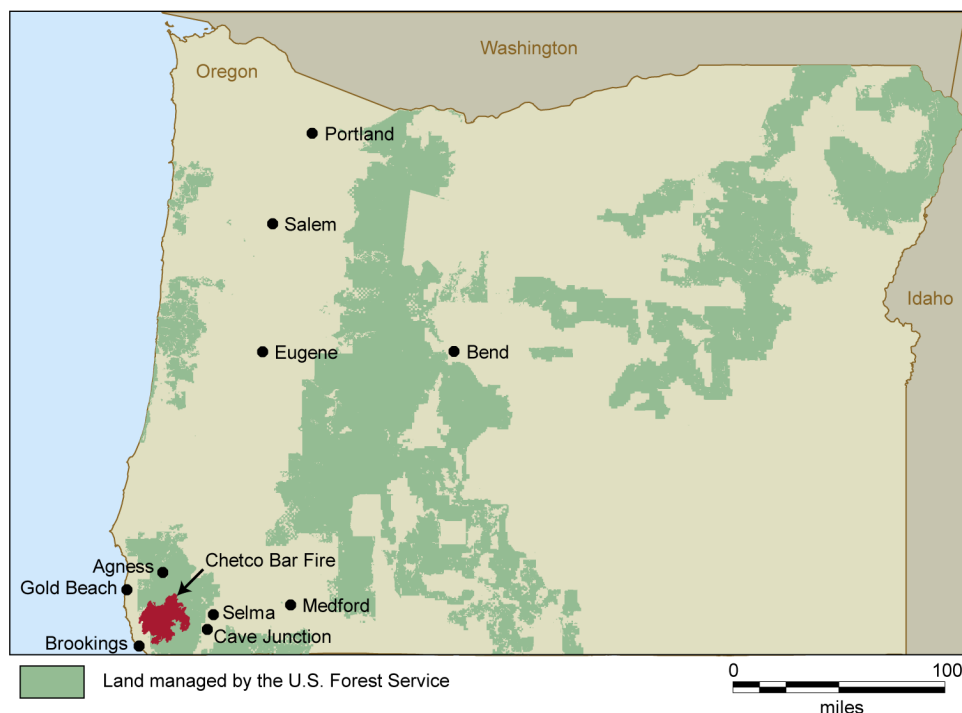
The Rogue River-Siskiyou National Forest, located mainly in southwestern Oregon and extending into northern California, encompasses nearly 1.8 million acres. The west side of the forest lies within the Klamath-Siskiyou ecoregion, which is known for its ecological diversity, with 28 coniferous tree species and numerous rare and endemic plants.¹⁰ The forest also contains diverse topography, with steep terrain and rugged geological features across several mountain ranges, including the Klamath Mountains, Siskiyou Mountains, Cascade Range, and Coast Range. Access to the forest is limited, due to many roadless areas and over 340,000 acres of wilderness, including the 180,000-acre Kalmiopsis Wilderness, where the Chetco Bar Fire began. Cities and communities in Oregon near the fire include Brookings and Gold Beach—along the coast of the Pacific Ocean—as well as Agness, Cave Junction, and Selma in

⁹U.S. Department of Commerce, National Institute of Standards and Technology, *The Costs and Losses of Wildfires: A Literature Review, Special Publication 1215* (Gaithersburg, MD: November 2017); and Headwaters Economics, *The Full Community Costs of Wildfire* (Bozeman, MT: May 2018).

¹⁰Ecoregions are geographical regions of similar climate that are characterized by specific ecological patterns, including soil health and flora and fauna, among other factors. Endemic plants are unique to one location, such as a geographic region (such as the Pacific Northwest), a specific mountain range, or even a single island.

Curry and Josephine counties. Figure 1 shows the final perimeter of the fire in southwest Oregon.

Figure 1: Map of Oregon with the Location of the Chetco Bar Fire



Source: GAO analysis of U.S. Census Bureau and U.S. Forest Service information. | GAO-20-424

The part of southwestern Oregon where the Rogue River-Siskiyou National Forest is located is a fire-adapted ecosystem, meaning that most native species and plant communities have evolved with fire, and many are adapted to or dependent on periodic wildfires. The historic fire interval in the area where the Chetco Bar Fire occurred varied, as did the historic severity of fires, according to a Forest Service ecologist. The forest experienced a number of fires over the 30 years before the Chetco Bar Fire occurred. In 1987, the Silver Fire burned nearly 100,000 acres. Fifteen years later, in 2002, the Biscuit Fire burned nearly 500,000 acres, including areas previously burned by the Silver Fire.¹¹ The Chetco Bar

¹¹We issued two reports on the Biscuit Fire response and recovery efforts: GAO, *Biscuit Fire: Analysis of Fire Response, Resource Availability, and Personnel Certification Standards*, [GAO-04-426](#) (Washington, D.C.: Apr. 12, 2004) and *Biscuit Fire Recovery Project: Analysis of Project Development, Salvage Sales, and Other Activities*, [GAO-06-967](#) (Washington, D.C.: Sept. 18, 2006).

Fire started in the areas burned by both the Silver and Biscuit Fires. In 2018, the year after the Chetco Bar Fire, the forest experienced another large fire, the Klondike Fire, which burned about 175,000 acres, abutting the burn scar of the Chetco Bar Fire in some places.

Frequency and Risk of Wildfires in the Western United States

The occurrence of large fires in the western United States has been increasing, while, at the same time, fire seasons have been increasing in length, according to recent assessments.¹² Some of these assessments have found that these increases are due in part to climate change, which has contributed to increasing temperatures and droughts in the West, as well as a later onset of fire-season-ending rains. We have previously found that the cost of disasters, including wildfires, is projected to increase as extreme weather events such as droughts become more frequent and intense due to climate change.¹³

Moreover, land use practices have increased the risk that severe and intense wildfires will affect people and communities. As we have previously described, land use practices over the past century have reduced forest and rangeland ecosystems' resilience to fire.¹⁴ In particular, fire suppression—with 95 percent or more of fires suppressed for nearly a century—and timber harvesting and reforestation have contributed to abnormally dense accumulations of vegetation, and these accumulations can fuel uncharacteristically large or severe fires. In some parts of southwestern Oregon, significant vegetation has built up,

¹²See Booz Allen Hamilton (developed on behalf of the Forest Service and Department of the Interior), *2014 Quadrennial Fire Review Final Report* (Washington, D.C.: May 2015). See also U.S. Global Change Research Program, *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, E.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)] (Washington, D.C., 2017). The U.S. Global Change Research Program is a federal program mandated by the Global Change Research Act of 1990 that coordinates federal research and investments in understanding the forces shaping the global environment, both human and natural, and their impacts on society. Pub. L. No. 101-606, § 103, 104 Stat. 3096, 3098 (1990). See also Holden, Z.A., A. Swanson, C.H. Luce, W.M. Jolly, M. Maneta, J.W. Oyler, D.A. Warren, R. Parsons, and D. Affleck, "Decreasing fire season precipitation increased recent western US forest wildfire activity," in *Proceedings of the National Academy of Sciences*, vol. 115 (July 23, 2018): pp. E8349-E8357.

¹³Also see GAO, *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas*, [GAO-19-157SP](#) (Washington, D.C.: Mar. 6, 2019).

¹⁴See, for example, GAO, *Wildland Fire: Federal Agencies' Efforts to Reduce Wildland Fuels and Lower Risk to Communities and Ecosystems*, [GAO-20-52](#) (Washington, D.C.: Dec. 19, 2019) and *Wildland Fire Risk Reduction: Multiple Factors Affect Federal-Nonfederal Collaboration, but Action Could Be Taken to Better Measure Progress*, [GAO-17-357](#) (Washington, D.C.: May 10, 2017).

according to Forest Service and other documents. As a result, southwestern Oregon, as well as other parts of the country, is under high to very high risk from fire, according to a risk assessment and Forest Service presentation.¹⁵ At the same time, development in and around wildland areas continues to increase, placing more people, businesses, and infrastructure at risk of being affected by fires.¹⁶

Fighting Wildfires in the United States

Because a single firefighting entity may not be able to handle all wildfires in its jurisdiction, agencies in the United States use an interagency incident management system that depends on the close cooperation and coordination of federal, state, tribal, and local fire protection agencies. The Forest Service is the predominant federal firefighting agency in terms of funding.¹⁷ Other federal firefighting agencies include the Bureau of Indian Affairs, BLM, Fish and Wildlife Service, and National Park Service. Federal and nonfederal firefighting entities generally share their firefighting personnel, equipment, and supplies and work together to fight fires, regardless of who has jurisdiction over the burning lands. Agreements between cooperating entities govern these firefighting efforts and contain general provisions for sharing firefighting assets and costs.

On a large wildfire, firefighting efforts generally fall into two phases—initial attack and extended attack. The initial attack phase consists of the efforts to control a fire during the first “operational period” after the fire is reported, generally 24 hours.¹⁸ While the majority of fires on Forest Service land are controlled and suppressed during initial attack, some

¹⁵Julie W. Gilbertson-Day, Richard D. Stratton, Joe H. Scott, Kevin C. Vogler, and April Brough, *Pacific Northwest Quantitative Wildfire Risk Assessment: Methods and Results*, a report prepared by Quantum Spatial and Pyrologix at the request of the Forest Service and Bureau of Land Management, Apr. 9, 2018, and Forest Service, *Southwest Oregon: Large Fire History, Risk Assessment, and Home/Community Protection* (Grants Pass, OR: Apr. 19, 2019).

¹⁶According to a report developed on behalf of the Forest Service and Interior, there are approximately 46 million single-family homes in the wildland-urban interface (the area where houses are in or near wildland vegetation) in the United States. Booz Allen Hamilton, *2014 Quadrennial Fire Review Final Report*.

¹⁷According to the Forest Service’s budget justification for fiscal year 2020, the Forest Service spent about \$2.2 billion on fire suppression in fiscal year 2017, which the agency stated was the most expensive fire season to date. The Forest Service requested about \$1.0 billion for fire suppression for fiscal year 2020. According to Interior’s Wildland Fire Management budget justification for fiscal year 2020, Interior spent about \$508 million on fire suppression in fiscal year 2017 and requested about \$384 million in fiscal year 2020.

¹⁸An operational period is the period of time scheduled for execution of a given set of tactical actions as specified in an incident action plan. Operational periods can be of various lengths, although usually not more than 24 hours.

fires require further firefighting efforts. Such additional efforts are referred to as extended attack.

The Forest Service and its interagency cooperators use an incident management system designed to provide appropriate leadership of firefighting efforts. There are five types of incidents, ranging in complexity from type 5 (least complex) to type 1 (most complex). The fire's complexity determines the type of incident commander and management team assigned. For example, for a type-5 incident, the incident commander may be a local employee qualified to direct initial attack efforts on a small fire with two to six local firefighters. In contrast, for a type-1 incident, the incident commander is one member of a highly qualified incident management team, often with more than 500 firefighters and other personnel. There are sixteen interagency type-1 incident management teams that operate nationwide and are typically deployed to fires for 14-day assignments. In addition, the Forest Service has four type-1 incident management teams under its National Incident Management Organization (NIMO). The Forest Service calls these "short" teams; each team has seven full-time members, but they can add additional members as needed. NIMO teams generally handle complex fires, including long-duration fires, so as not to tie up critical firefighting personnel over a long time.

A single incident management team, under the direction of the agency administrator (the line officer, such as the forest supervisor or district ranger, responsible for management of the incident), is typically in charge of a fire, but the incident management system may be expanded into a unified command structure when multiple jurisdictions are involved. This structure brings together incident commanders from the relevant jurisdictions to facilitate a coordinated and integrated interagency response. In such cases, members of the unified command work together to develop a common set of incident objectives and strategies, maximize the use of firefighting assets, and enhance the individual jurisdictions' efficiency.

Once assigned to a fire, an incident management team works with local line officers and fire management staff to determine the strategy and tactics to use in managing the fire. The strategy is the overall plan designed to control the fire; for example, to protect structures and contain the fire within a certain geographic area. Tactics are actions taken to accomplish the objectives set out in the strategy. For example, the fire may be attacked directly, with firefighters working at the fire's edge to extinguish it. If direct attack is not possible, practical, or safe—because

the fire is burning too intensely or on very steep slopes, for example—firefighters may choose to attack it indirectly. In such cases, firefighters typically select an area away from the fire and construct a “fireline,” where vegetation is cleared in an effort to stop the fire’s spread at that point or slow it sufficiently to allow firefighters to attack directly. Firefighters often incorporate geographic features such as roads, rocky areas, ridgelines, and rivers into firelines to increase their effectiveness. In some cases firefighters conduct burnout operations, in which they intentionally set fire to fuels between a fireline and the main fire perimeter to slow or contain a rapidly spreading fire by depriving it of fuel.

In carrying out strategies and tactics, firefighters use a variety of firefighting assets, both on the ground and in the air.¹⁹ Ground-based assets include firefighting crews, wildland fire engines, and machinery such as bulldozers, which firefighters use to help construct firelines. When providing personnel to fight fires, the Forest Service and other federal agencies generally rely on a “militia” strategy whereby personnel within each agency are trained to serve in firefighting roles when needed, in addition to performing their day-to-day work responsibilities. Air-based assets include helicopters and fixed-wing air tankers. Helicopters generally drop water directly on a fire, whereas air tankers generally drop fire retardant ahead of the fire, often near a fireline that has been constructed, to slow a fire’s spread.²⁰ Air tankers range in size from small single-engine air tankers, which are maneuverable but carry only small amounts of retardant, to large aircraft such as converted DC-10s or Boeing 747s—referred to as “very large air tankers”—which can carry

¹⁹Assets are ordered through a system of local, regional, and national dispatch centers. If assets are insufficient in the local dispatch area close to the fire, the local center forwards requests to the regional dispatch center, which locates and sends additional firefighting assets from within the region. Eleven regional dispatch centers, called geographic area coordination centers, are located nationwide, each of which serves a specific geographic portion of the United States. Similarly, if assets are insufficient within the region where a fire is burning, the regional dispatch center can request additional assets from other regions across the nation. The Northwest Interagency Coordination Center in Portland, Oregon, is the geographic area coordination center that serves the area where the Chetco Bar Fire occurred.

²⁰Air tankers may also drop water or retardant directly on a fire.

substantial amounts of retardant but whose use can be limited in mountainous terrain because of their size.²¹

The level of risk that decision makers and firefighters are willing to accept in any given situation depends on the experience and training of those involved. Overall, agency firefighting doctrine emphasizes safety above all other concerns; Forest Service policy, for example, states, “In conducting wildland fire suppression, responsible officials shall give first priority to the safety of firefighters, other personnel, and the public.” Firefighters and other personnel who respond to wildland fire incidents are required to complete training to help them identify risks as well as develop appropriate strategies and tactics to respond to different situations.²²

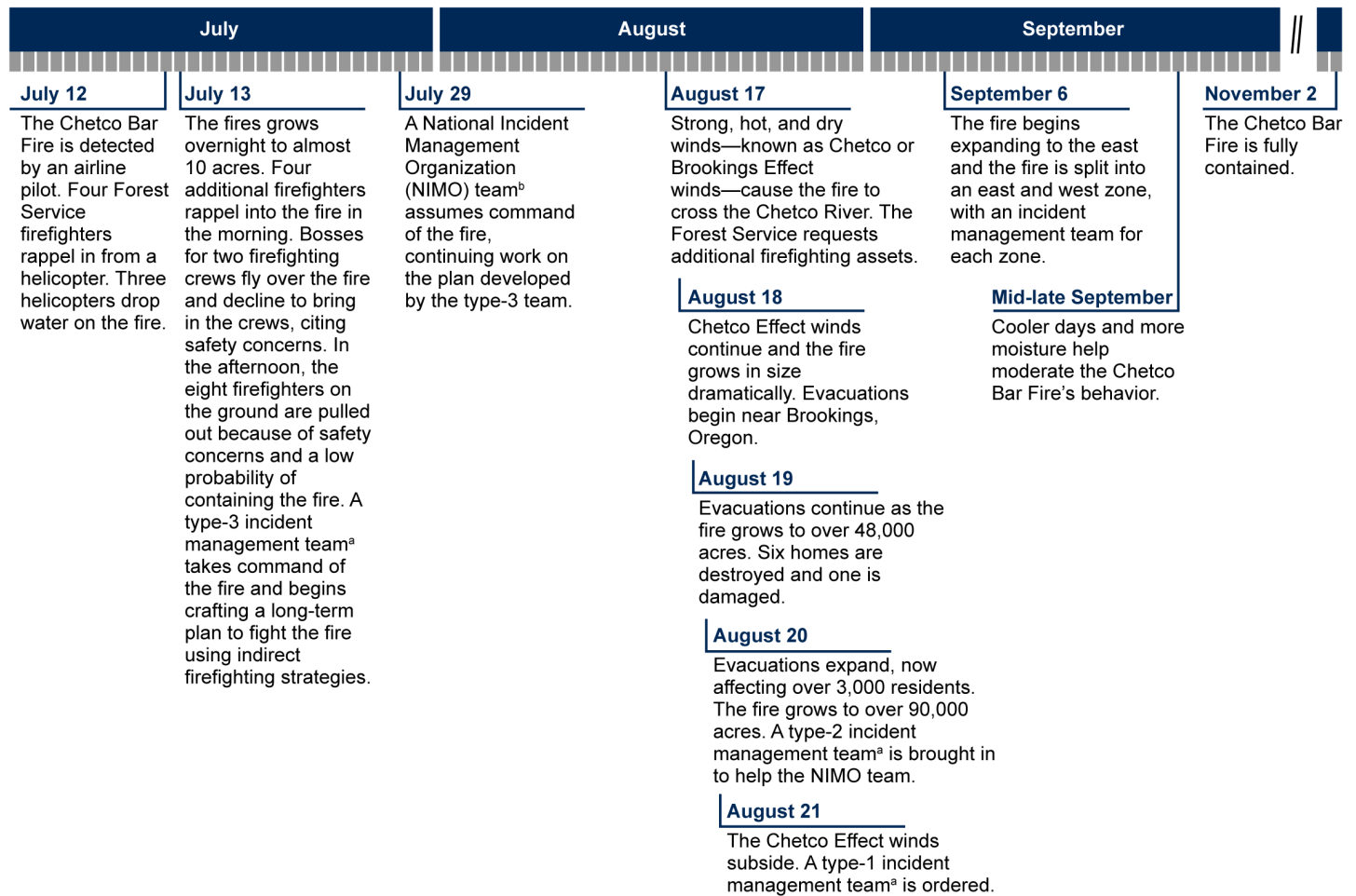
Key Events of the Chetco Bar Fire and Forest Service’s Response Included an Unsuccessful Initial Firefighting Attack and Rapid Spread of the Fire by Strong Winds

The Chetco Bar Fire grew slowly in the summer of 2017 before undergoing a period of rapid growth driven by strong, hot winds. In response, the Forest Service and other agencies undertook various firefighting strategies and tactics over different phases of the fire, described below. Figure 2 provides a timeline of the fire’s key events.

²¹Fire retardant is most effective when applied ahead of the fire rather than directly on a fire. According to the Forest Service, the DC-10 has a capacity of 11,000 gallons, and the 747 has a capacity of 19,400 gallons, substantially more than the approximately 3,000 gallons that a standard large air tanker can carry. The 747 was not available for federal use in 2017, according to the Forest Service. The Forest Service obtains air tanker services through contracts with private industry.

²²Core training for federal wildland firefighters requires a series of courses from the National Wildfire Coordination Group, including Firefighter Training, Introduction to Wildland Fire Behavior, and Potential Hazards and Human Factors on the Fireline. These courses cover a wide range of topics, such as identifying and avoiding high-risk situations, constructing fireline, and extinguishing fire with and without the use of water.

Figure 2: Key Events of the Chetco Bar Fire, July through November 2017



Source: GAO analysis of U.S. Forest Service information. | GAO-20-424

^aIncident management teams are rated on a scale according to their training and experience. Type-3 teams generally operate at the local level to handle smaller incidents, whereas type-1 teams are qualified to handle the most complex incidents and are deployed across the country.

^bNIMO teams are relatively small type-1 incident management teams but can expand as needed. Among other things, they focus on the management of complex wildfires, including ones that are expected to be of long duration.

Initial Firefighting Attack in Remote, Steep Terrain Was Not Successful (July 12-13, 2017)

In the initial phase (July 12-13, 2017), the Chetco Bar fire was relatively small and inaccessible. When the fire was first detected on July 12, it was estimated to be between one quarter and one half acre in size, burning in remote, steep terrain in the Kalmiopsis Wilderness in the Rogue River-

Siskiyou National Forest.²³ The fire's initial location was several miles from the closest road access point. No properties or other "values at risk" (such as structures, other property, and natural and cultural resources that could be damaged by a wildfire) were in the immediate vicinity of the fire, according to Forest Service documents and officials.

The Forest Service was notified of the Chetco Bar Fire at 2:43 p.m. on July 12 and, at 4:14 p.m., four Forest Service firefighters rappelled from a helicopter to assess the fire. The rappellers landed on a ridge above the fire to create a helispot (a temporary helicopter landing area) so that additional firefighters and equipment could more easily be brought to the fire.²⁴ The rappellers requested and received permission from the district ranger for chainsaw use in the Kalmiopsis Wilderness to prepare the helispot, and they worked on cutting trees and clearing brush until late that evening, according to Forest Service documents and national forest officials.²⁵ The rappellers estimated that the helispot was 60 percent cleared by the end of the first day, according to national forest officials.

While the rappellers were working, the Forest Service helicopter returned to its base near Grants Pass, Oregon, to attach a bucket to drop water onto the fire. In the meantime, two helicopters from the Oregon Department of Forestry headed to the fire. The three helicopters dropped about 17,000 gallons of water the first day, according to Forest Service documents. Forest Service officials said these water drops were intended to slow the spread of the fire while the rappellers worked to clear the helispot.

Anticipating that the helispot would be completed shortly, the Forest Service ordered two 20-person crews to assist in firefighting efforts the next day. As the rappellers set up camp for the night, incident command

²³The Chetco Bar Fire was first detected by a commercial airline pilot on July 12 but the exact date it started is unknown. According to Forest Service and Oregon Department of Forestry documents, the fire likely started during lightning storms that occurred on June 24 and 25, 2017. Some residents affected by the Chetco Bar Fire told us that they believed that the fire was human-caused.

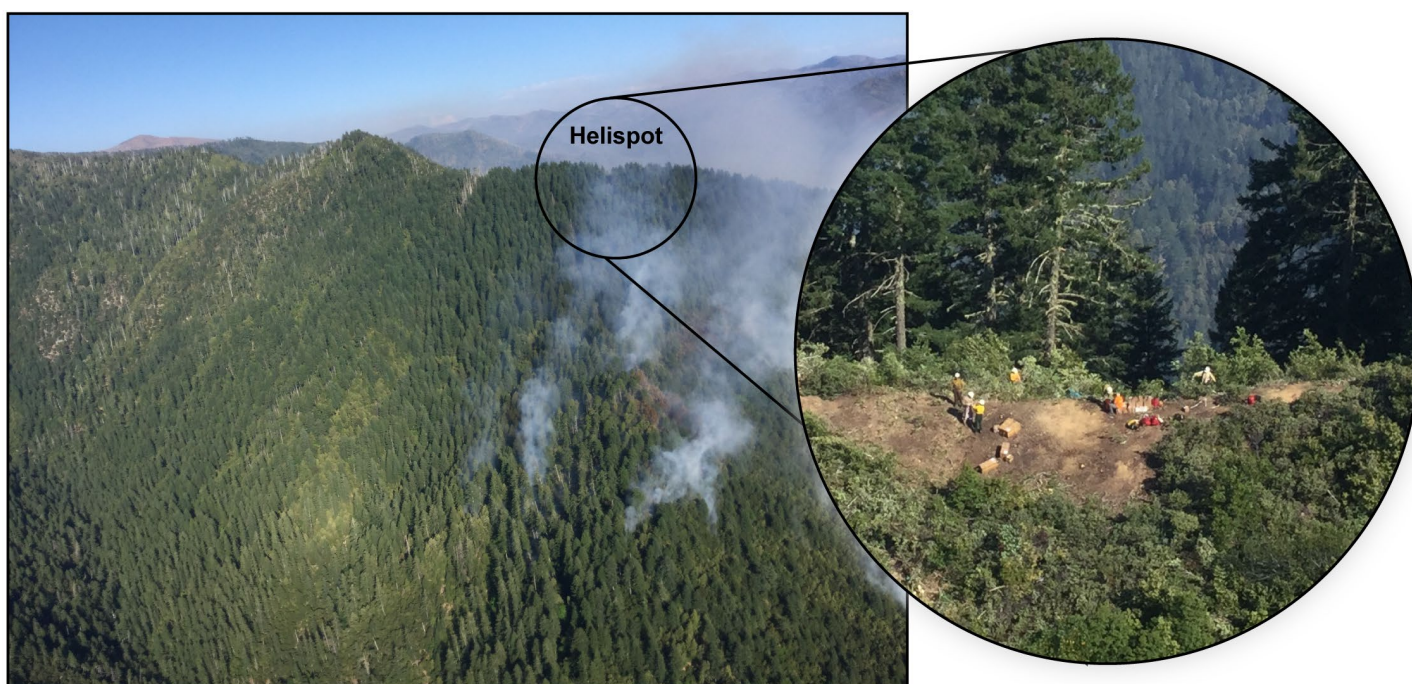
²⁴Forest Service officials said rappellers often drop below a fire since it is generally safer given that fires often burn uphill. They said the rappellers decided to go above the Chetco Bar Fire because it was the best location for a helispot, allowing the option of bringing in additional firefighters and evacuating them by air, if needed.

²⁵The Wilderness Act provides that, except as necessary to meet minimum requirements for the administration of a wilderness area, there shall be no use of motorized equipment within the area. 16 U.S.C. § 1133(c).

radioed them to say that the fire appeared to be holding at about three quarters of an acre.

The next morning, July 13, the Forest Service brought in four additional rappellers to continue working on the helispot throughout the morning and into the afternoon (see fig. 3). One of the rappellers walked the perimeter of the fire and determined that the fire had grown to about 10 acres overnight. While the rappellers were working, two helicopters dropped about 18,000 gallons of water that day and a single engine air tanker dropped 1,200 gallons, according to a Forest Service document.

Figure 3: Helispot Being Constructed above the Chetco Bar Fire, July 13, 2017.



Source: U.S. Forest Service. | GAO-20-424

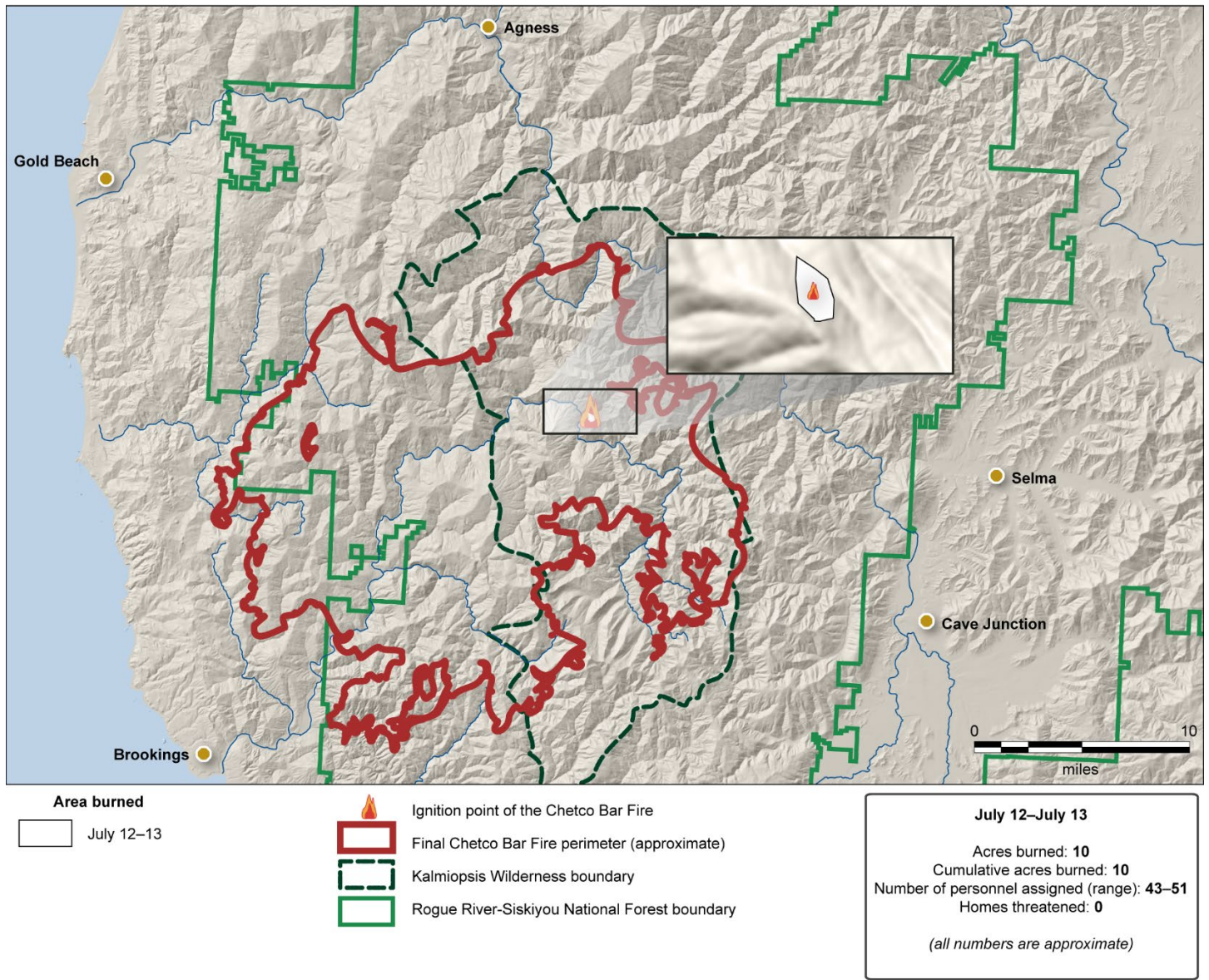
The crew bosses for the two crews that had been ordered the previous day flew over the fire early afternoon of July 13, according to Forest Service documents. They estimated the fire had grown to about 15 acres and observed a number of spot fires (smaller fires separate from the main fire) caused by burning material rolling down the hill. They expressed safety concerns about bringing crews into that area and also determined the helispot needed more work before a helicopter could land safely.

Since the crews would need to be shuttled in by helicopter, the crew bosses decided not to bring in the requested crews, according to officials.

Later that day, the incident commander requested a helicopter to remove the eight rappellers from the fire because of safety concerns and a low probability of success at containing the fire, according to the incident commander and Forest Service documents. The rappellers said that it was taking much longer to complete the helispot than initially anticipated and they did not have a good safety zone or escape route.²⁶ They also noted that there was unburned vegetation on the slope between the fire and the helispot they were constructing—a dangerous situation if the fire started to spread quickly. The rappellers were removed by 5:00 p.m., at which time the helicopters also stopped dropping water. Figure 4 shows the ignition point of the Chetco Bar Fire and the fire's growth as of July 13, 2017.

²⁶According to rappel crew members, work on the helispot was slowed by the number of large trees they needed to cut down and by the presence of tan oak, which can irritate firefighters' lungs when burning, and manzanita (an evergreen shrub), which can cause chainsaws to throw their chains, slowing firefighters' progress.

Figure 4: Rogue River-Siskiyou National Forest and Vicinity, with Ignition Point and Extent of the Chetco Bar Fire as of July 13, 2017, Compared with Final Perimeter of the Fire



Source: GAO analysis of U.S. Forest Service information; U.S. Forest Service (map). | GAO-20-424

Fire Grew Slowly over
Several Weeks as
Firefighters Pursued
Indirect Strategies (July
14-August 16, 2017)

In the second phase of the fire, Rogue River-Siskiyou National Forest officials assigned a type-3 incident management team to manage the response to the Chetco Bar Fire, following the unsuccessful initial attack. Forest Service documents indicated that fire behavior was moderate over the next several weeks, averaging around 150 acres of growth per day.²⁷ The Chetco Bar Fire was a relatively low-priority fire during this phase, since it was far from values at risk and it remained within the Kalmiopsis Wilderness, while other fires in the region were threatening communities and resources, according to Forest Service documents and incident management team officials.²⁸

Because firefighters had been unable to suppress the fire during initial attack, national forest officials said they anticipated, based on knowledge of previous fires in the area, that the Chetco Bar Fire would become a long-term incident. The type-3 incident management team completed a long-term assessment and began working to contain the fire using long-term, indirect strategies.²⁹ Under the type-3 team, crews scouted potential locations to fight the fire and started building firelines some distance away, approximately 6 miles from the fire and outside of the wilderness boundary, according to a Forest Service document and an incident management team official. Several additional fire crews were assigned to work on the fire during this time, with staffing fluctuating between approximately 40 and 140 people per day.

As the type-3 team's 2-week rotation was ending, national forest officials decided to bring in a NIMO team to assume command of the fire. Officials said they brought in a NIMO team because it consisted of type-1-qualified staff who could be staffed on the fire for longer than 2 weeks, and the

²⁷Fire behavior is the manner in which fuel ignites, flames develop, and fire spreads.

²⁸On July 14, 2017, the region had 15 fires, six of which were uncontained large fires, and on August 16, 2017, it had 32 fires, 15 of which were uncontained large fires.

²⁹Forest Service, *Chetco Bar Fire Long Term Risk Assessment of Not Burning Out to River* (Gold Beach, OR: July 26, 2017); and *Chetco Bar Fire Long Term Analysis* (Gold Beach, OR: July 30, 2017). A long-term assessment evaluates the threat to values at risk relative to the fire's current location, projects short-term fire behavior, and models the fire's potential spread over 7-, 30-, and 45-day time periods.

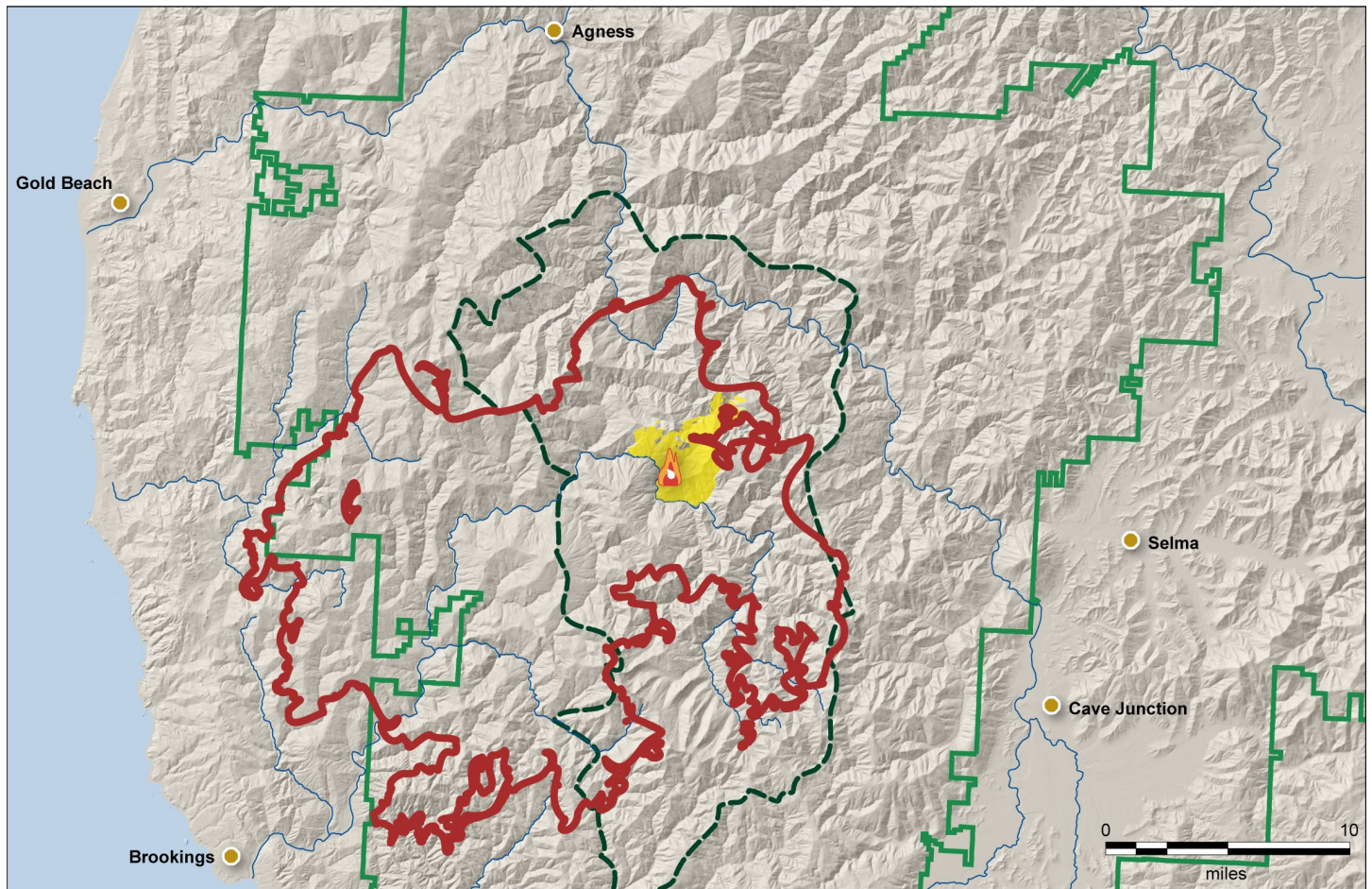
team could expand or contract as needed.³⁰ The NIMO team took command of the fire on July 29, with the fire estimated at 2,181 acres in size, and started updating the type-3 team's long-term assessment and developing a long-term implementation plan.³¹ The plan identified 13 trigger points, referred to as "management action points," to help guide decision-making on protecting high values at risk if certain conditions were met. For example, the plan laid out actions to prevent the fire from crossing the Chetco River—the first trigger point identified—and actions to be taken if the fire crossed the river.

The NIMO team continued the type-3 team's efforts to construct a series of firelines away from the main fire and, according to a team summary document, completed all of the firelines by August 17. Forest Service officials told us that for these firelines to be effective, firefighters would have needed to burn the vegetation between the lines and the fire itself (known as a burnout). National forest and NIMO team officials said that the teams had not yet taken this step because they considered it an unnecessary risk as long as the fire remained north of the Chetco River. These officials said that burnout operations pose risks if the fire set by firefighters burns in a different direction than intended, and such operations can unnecessarily burn a larger area of the forest if the fire does not reach the burnout. Therefore, one national forest official said firefighters will prepare firelines but not conduct burnout operations until the incident management team determines they are needed—particularly since safety risks can be associated with conducting burnout operations. Figure 5 shows the Chetco Bar Fire's growth from July 14 through August 16, 2017.

³⁰The other option officials considered was to order a type-2 incident management team, which officials said had the advantage of being a larger team, generally consisting of about 50 people. Officials said that they believed the NIMO team was a good option to provide consistent leadership since they expected a long-duration fire, whereas the type-2 team would have to rotate off of the fire after approximately 2 weeks.

³¹Forest Service, *Chetco Bar Fire Long Term Assessment & Implementation Plan* (Gold Beach, OR: Aug. 16, 2017). Computer modeling of potential 30-day fire growth from August 6 through September 6 showed that the fire could potentially spread as far as the edges of Brookings under the right conditions, but that this was a very low probability scenario (less than 0.2 percent). The NIMO team also followed information in a July 19 memo that was developed as part of the Wildland Fire Decision Support System, which is a national interagency system assisting fire managers and analysts in making and documenting strategic and tactical decisions for fires.

Figure 5: Rogue River-Siskiyou National Forest and Vicinity, with Extent of the Chetco Bar Fire as of August 16, 2017, Compared with Final Perimeter of the Fire



- Area burned**
- July 12–13
 - July 14–August 16
- Ignition point of the Chetco Bar Fire
 - Final Chetco Bar Fire perimeter (approximate)
 - Kalmiopsis Wilderness boundary
 - Rogue River-Siskiyou National Forest boundary

July 14–August 16

Acres burned: **6,006**
 Cumulative acres burned: **6,016**
 Number of personnel assigned (range): **40–141**
 Homes threatened: **0**

(all numbers are approximate)

Source: GAO analysis of U.S. Forest Service information; U.S. Forest Service (map). | GAO-20-424

Fire Expanded Rapidly because of Strong Winds, and Firefighting Response Began to Escalate (August 17-August 21, 2017)

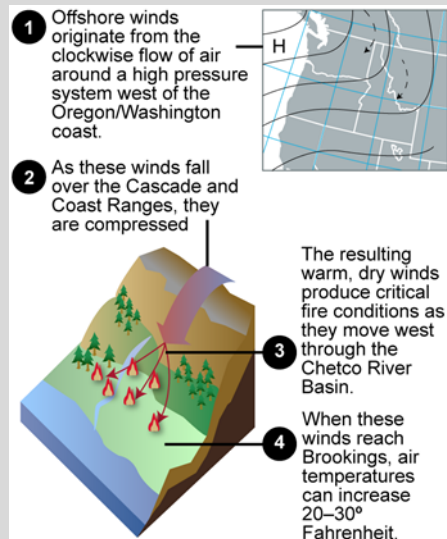
As the fire burned into August, hotter and drier weather created conditions for more active fire behavior in the third phase of the fire.³² Chetco Effect winds developed in mid-August 2017, causing the Chetco Bar Fire to rapidly expand and intensify (see sidebar). The Forest Service was aware of the potential for such winds, as fire behavior modeling and the July 2017 long-term assessment showed the potential for these winds to increase fire behavior dramatically by mid-August.³³ The winds, combined with dry fuels and heavy vegetation, created conditions that led to extreme fire behavior.

³²August 2017 was the warmest month on record for parts of Oregon, according to a Forest Service document.

³³Forest Service, *Chetco Bar Fire Long Term Risk Assessment of Not Burning Out to River*, and *Chetco Bar Fire Long Term Analysis*. The long-term analysis showed the possibility of a Chetco Effect wind event lasting 2 to 5 days and increasing fire behavior the longer it occurred. The risk assessment also noted that if the fire became established in a susceptible location—specifically, near Tincup Creek, southwest of the ignition site on the other side of the Chetco River—during a wind event, the fire would likely continue traveling down the river toward Brookings. Fire behavior modeling from late July showed the fire had the potential to spread as far as Brookings by mid-September but that such spread was a low probability event.

Chetco Effect Winds

Chetco Effect winds, also known as Brookings Effect winds, are warm, dry, and strong winds flowing down the Chetco River Basin toward Brookings, Oregon (see figure below). Such winds are more broadly referred to as Foehn or downslope winds, other examples being the Santa Ana winds in southern California and the Diablo winds in northern California. Chetco Effect winds can happen any time and generally occur two to four times a year, according to the National Weather Service.

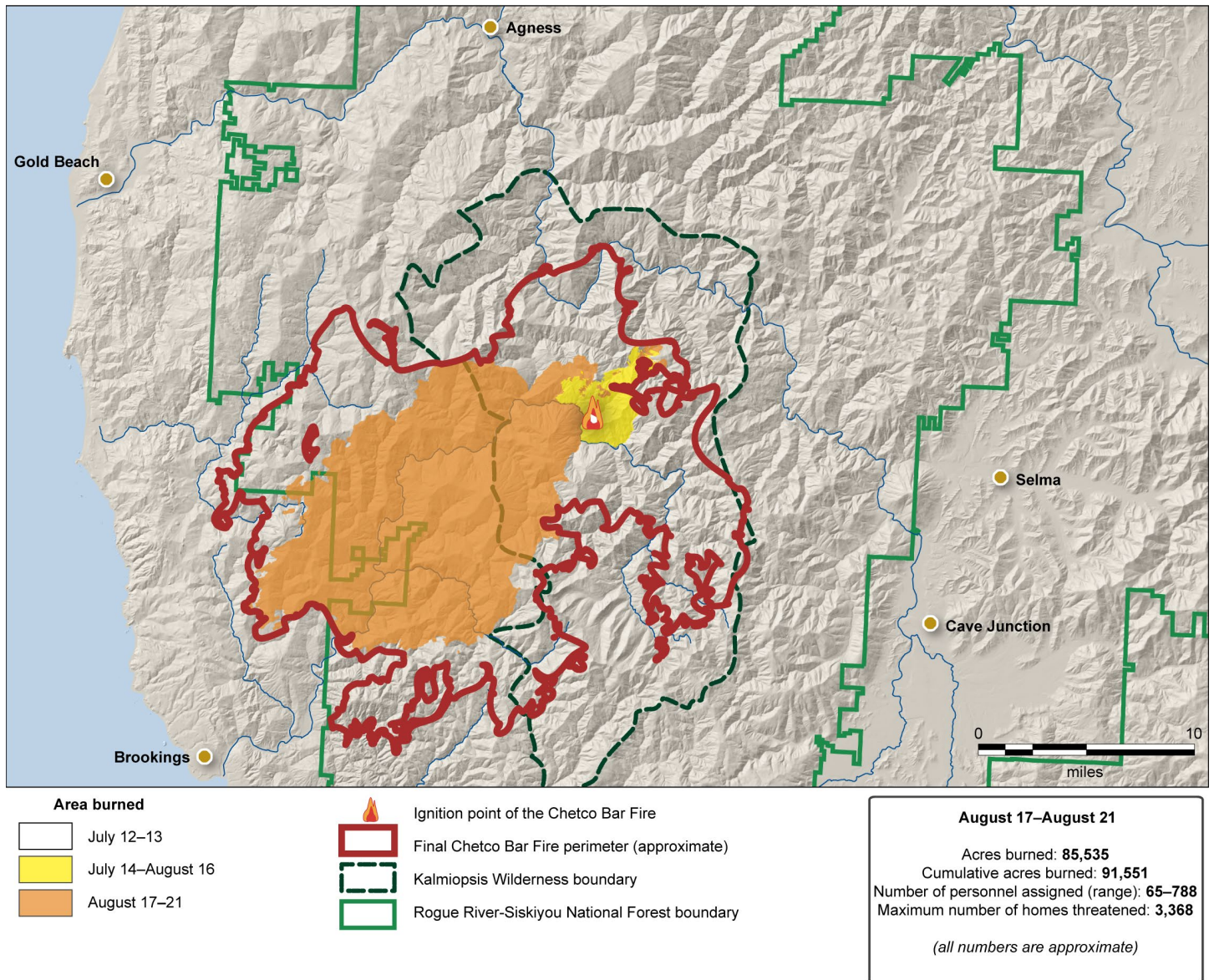


Source: GAO analysis of information from the National Weather Service. | GAO-20-424

The Chetco Effect winds first occurred the evening of August 15 and morning of August 16, but the fire remained north of the Chetco River. When the winds returned the evening of August 16 and morning of August 17, the fire crossed the river and began expanding rapidly, in part because heavy vegetation on the south side of the river fueled the fire under the winds.³⁴ Many officials and stakeholders said nothing could be done to moderate the fire’s behavior when the Chetco Effect winds were in effect. The fire increased in size from 8,500 acres on August 17 to 91,551 acres on August 21 (see fig. 6). As a result, the Chetco Bar Fire became a much higher priority fire, according to Forest Service documents.

³⁴During the 2002 Biscuit Fire, the area south of the Chetco River burned at low intensity whereas the area north of the river, where the Chetco Bar Fire started, burned at higher intensity. As a result, there was more vegetation on the south side of the river.

Figure 6: Rogue River-Siskiyou National Forest and Vicinity, with Extent of the Chetco Bar Fire as of August 21, 2017, Compared with Final Perimeter of the Fire



Source: GAO analysis of U.S. Forest Service information; U.S. Forest Service (map). | GAO-20-424

The NIMO team ordered additional crews on August 17, in anticipation of conducting burnout operations along 10 miles of fireline in an attempt to slow the fire, according to Forest Service documents.³⁵ However, the Chetco Effect winds caused the fire to move rapidly toward and past the fireline before the Forest Service could conduct the planned burnouts. Even though the fireline was completed prior to being overrun by the fire, national forest officials told us that the weather conditions were not favorable for burnout operations, as the winds would have blown the burnout fires back toward private timberlands and populated areas. The winds also caused embers to fly far ahead of the fire during this time, creating spot fires 1 to 2 miles or more ahead of the main flame front.

On August 18, the Chetco Bar Fire began spreading from national forest onto private timberlands and unincorporated areas containing homes.³⁶ As the fire began to threaten homes and other structures, the NIMO team directed firefighters to take appropriate action to try to protect those structures, if fire behavior allowed.³⁷ For example, between August 18 and 21, Forest Service documents indicated that firefighters cleared brush around several structures and homes in a small community known as Wilderness Retreat and along two Forest Service roads.³⁸ On August 19, the fire burned rapidly toward Wilderness Retreat and firefighters conducted an emergency burnout, which successfully protected the community, according to a NIMO team document and national forest officials.³⁹ Around this time in another area, the Chetco Bar Fire burned

³⁵Forest Service, *Incident Status Summary (ICS-209)* (Aug. 17, 2017).

³⁶With the threat to private timberlands, the Forest Service established unified command with the Coos Forest Protective Association on August 19, 2017.

³⁷The NIMO team had limited firefighting assets for structure protection until after the Forest Service entered into unified command with the Oregon State Fire Marshal on August 20, according to NIMO documents. The Oregon State Fire Marshal entered unified command after Oregon's governor invoked the Conflagration Act, determining that the fire's threat to life, safety, and property exceeded the firefighting capabilities of local firefighting personnel and equipment. The Oregon Office of the State Fire Marshal then was able to mobilize firefighters and equipment to supplement local resources.

³⁸The structures included private structures located at Tolman Ranch and a Forest Service cabin known as Packer's Cabin. Wilderness Retreat is a community of about 50 homes located east of Brookings near the Rogue River-Siskiyou National Forest. On August 18, firefighters preparing to conduct a burnout around Packer's Cabin were trapped when a spot fire crossed the road that was their escape route. The firefighters were able to safely leave the following morning, once the spot fire cooled enough to allow their engine to drive through.

³⁹Forest Service, *Chetco Bar Fire Incident Summary* (Aug. 26, 2017).

six primary residences and more than 20 other structures, according to state and Forest Service documents.⁴⁰ On August 20, the fire traveled 6 miles toward Brookings in a single day, and threatened more than 3,000 homes during this phase.

As the Chetco Bar Fire burned toward Brookings, the NIMO team notified the Curry County Sheriff that residents would need to be evacuated. However, the rapid spread of the fire provided limited time to notify residents and conduct evacuations, according to a NIMO team document and national forest officials.⁴¹ The Curry County Sheriff's Office issued the first evacuation notices on August 18, and additional evacuation notices were issued between August 19 and 21.

As the fire expanded, the NIMO team ordered additional firefighting assets, increasing the ground assets assigned from 65 firefighters and 1 fire engine on August 17, 2017, to 788 firefighters and 90 fire engines by August 21. However, some assets ordered were not available because they were assigned to other fires in the region. In addition to ground assets, additional aircraft were ordered and assigned to assist the firefighting effort—such as two large and one very large air tankers, which dropped retardant on the fire on August 17 and August 18.⁴² The incident management team had requested two additional air tankers, but the requests were cancelled since aircraft were unavailable, according to a Forest Service document. Some ordered drops from air tankers also were cancelled because of poor visibility from smoke. Six helicopters were ordered during this phase, four of which were assigned to the fire, but the helicopters also were unable to fly due to smoke, according to flight communication logs and an incident management senior official.⁴³

With the Chetco Bar Fire's rapid growth, national forest officials decided to order a type-1 incident management team on August 21. Since mobilizing the team would take time, a type-2 team already in the vicinity

⁴⁰Oregon Office of the State Fire Marshal, Coos Forest Patrol, and Pacific Northwest Incident Management Team, *Chetco Bar Damage Inspection Report* (Aug. 24, 2017); Forest Service, *Chetco Bar Fire Incident Summary* (Aug. 26, 2017).

⁴¹Forest Service, *Chetco Bar Fire Incident Summary* (Aug. 26, 2017).

⁴²A Forest Service document noted two large air tankers and one very large air tanker dropped a combined 30,823 gallons of retardant on the fire on August 17.

⁴³One of the six helicopters was due to be released from the Chetco Bar Fire on August 21 but was reordered and reassigned to the fire. Another helicopter, which was assigned to the nearby Miller Complex Fire, dropped 30,000 gallons of water on the Chetco Bar Fire on August 18, according to a Forest Service document.

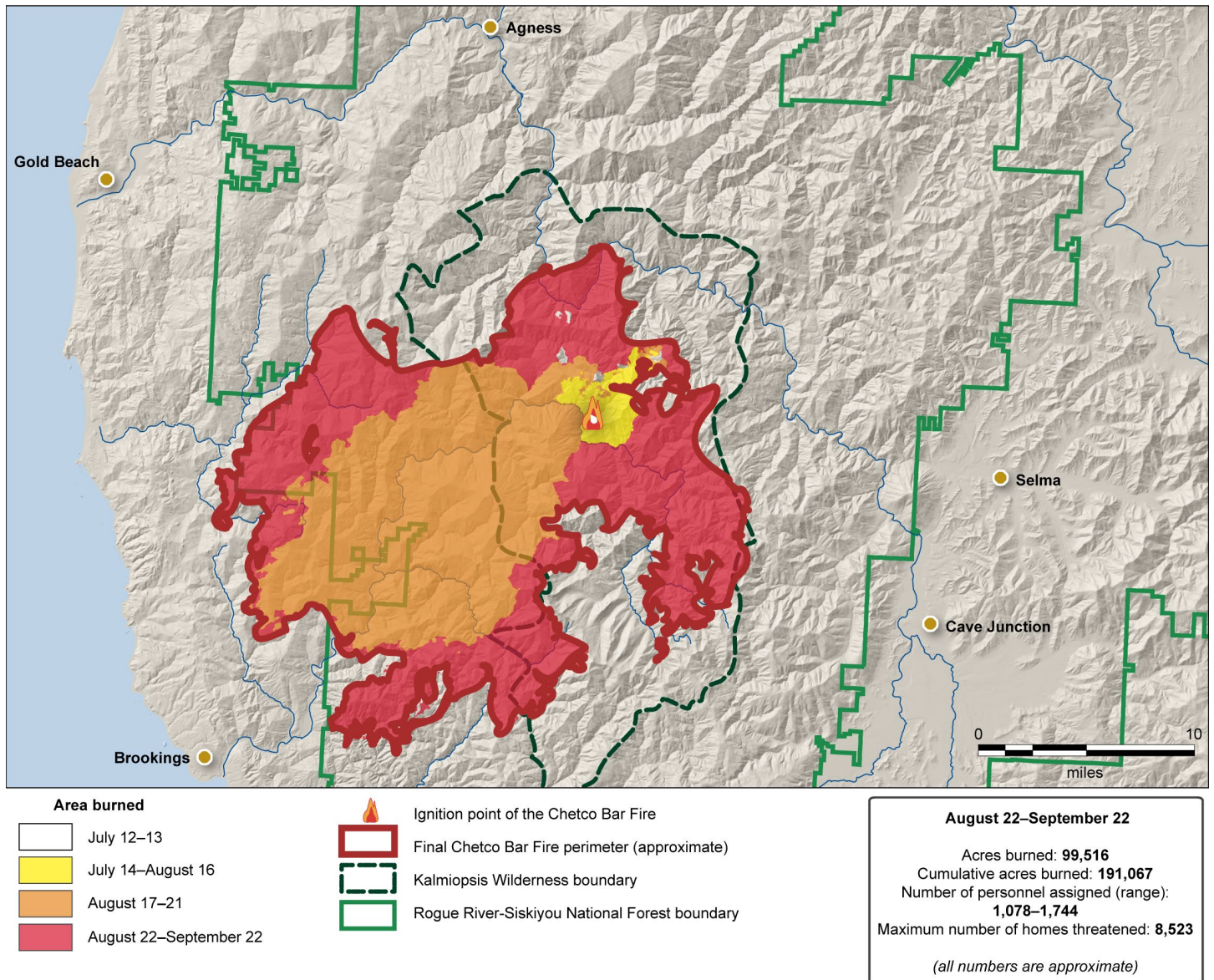
was brought in to assist the NIMO team on August 19. The type-1 team arrived on August 23 and assumed command on August 26, according to a team document.

Firefighting Response Continued to Escalate and Fire Burned Actively but Rate of Spread Slowed (August 22-September 22, 2017)

In the fourth phase, the Chetco Bar Fire continued to burn actively through the end of August and into September 2017, but the rate of its spread generally slowed. However, high temperatures and low humidity contributed to the fire growing from 97,758 acres on August 22 to 191,067 acres on September 22 (see fig. 7). Evacuations continued in the early part of this phase, threatening more than 8,500 homes during parts of September, but evacuation orders began to be lifted as the risk to homes declined.⁴⁴

⁴⁴For example, Josephine County issued evacuation notices starting on September 4, as the fire expanded east.

Figure 7: Rogue River-Siskiyou National Forest and Vicinity, with Extent of the Chetco Bar Fire as of September 22, 2017, Compared with Final Perimeter of the Fire



Source: GAO analysis of U.S. Forest Service information; U.S. Forest Service (map). | GAO-20-424

During this phase, the Forest Service ordered more firefighting assets, resulting in over 1,700 firefighters in total assigned to the fire. Between September 6 and 19, the fire began expanding to the east and the fire was divided into an east and west zone, with separate incident

management teams assigned to each zone. Firefighters constructed firelines to the south and west of the fire. Forest Service documents indicated the agency put in 128 miles of fireline cut by bulldozers and 52 miles of hand cut fireline, and used 141 miles of existing roads and 25 miles of natural features as firelines. Air tankers and helicopters continued supporting firefighters, dropping over 950,000 gallons of water, 55,000 gallons of retardant, and 10,000 gallons of gel during this phase, according to Forest Service documents. However, smoke from the fire hampered air operations, with one type-1 team reporting it was unable to conduct air operations for about half of the days it was in command (August 26 through September 9).⁴⁵ Firefighters gained substantial control of the fire during this phase, going from 0 percent containment on August 22 to 97 percent containment by September 22.

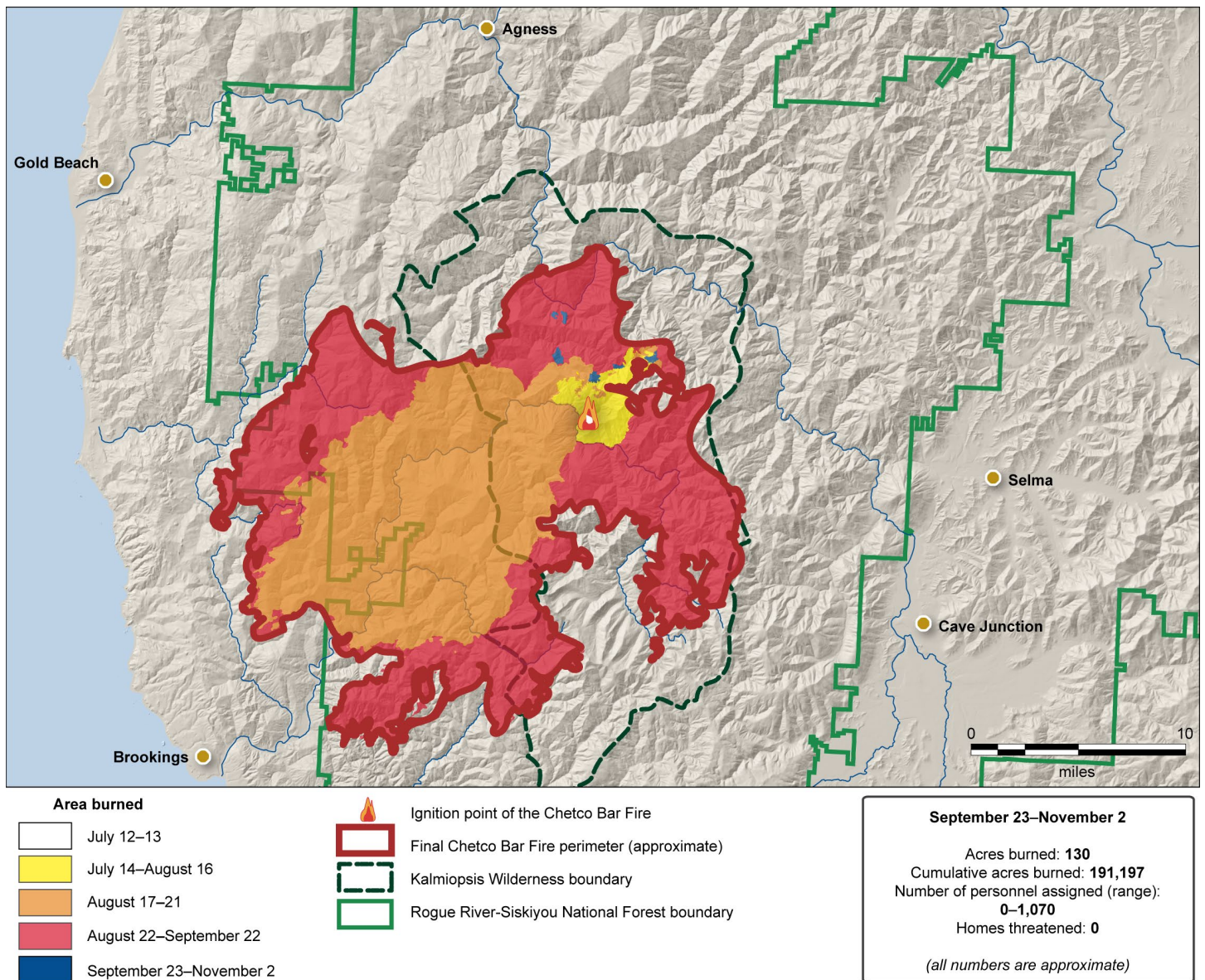
Fire Intensity Moderated because of Changing Weather, and Fire Was Ultimately Contained (September 23-November 2, 2017)

In mid- to late-September, the weather started to change, with cooler days and more moisture, which helped to moderate the fire's behavior. By September 23, the area had received several inches of rain, which nearly contained the fire, according to an incident management team document. Firefighting assets were released as the fire was contained. The Chetco Bar Fire was declared fully contained on November 2—nearly 4 months after it was detected. The fire burned a total of approximately 191,197 acres, according to the Forest Service's Burned Area Emergency Response (BAER) report (see fig. 8).⁴⁶

⁴⁵Several incident management teams rotated through during this phase. On September 1, an "area command" team was also ordered to assist in managing several large fires in the region, including the Chetco Bar Fire, Miller Complex, and High Cascades Complex. Area command teams are generally used to supervise and oversee incident management teams and help allocate firefighting assets among the fires. Area command had a delegation of authority from the regional forester from September 5 through 16.

⁴⁶The Forest Service estimated that the Chetco Bar Fire burned 191,197 acres, of which 170,321 acres were Forest Service land, 6,746 acres were BLM land, and 14,130 acres were private land. Forest Service, *Chetco Bar Burned Area Emergency Response Initial Authorization* (Portland, OR: Oct. 4, 2017).

Figure 8: Rogue River-Siskiyou National Forest and Vicinity, with Extent of the Chetco Bar Fire as of November 2, 2017



Source: GAO analysis of U.S. Forest Service information; U.S. Forest Service (map). | GAO-20-424

Officials and Stakeholders Raised Concerns about the Response to the Chetco Bar Fire, Such as the Aggressiveness of Firefighting and Extent of Communication

Forest Service officials and stakeholders we interviewed raised a number of concerns about the Forest Service's response to the Chetco Bar Fire. Many of these concerns related directly to the Forest Service's response to the fire; some related to broader agency programs that may have had an effect on fire behavior. We grouped these concerns into five categories: (1) aggressiveness of firefighting response, (2) availability of firefighting assets, (3) communication with cooperators, (4) communication with the public, and (5) timber harvest and other fuel reduction activities.⁴⁷ The Forest Service has taken steps that may help address some of the concerns, such as those related to communication. Agency officials and stakeholders expressed differing views about some of the concerns and whether changes were necessary.

Aggressiveness of Firefighting Response

Some national forest officials and many stakeholders we interviewed said that the Forest Service was not aggressive enough in fighting the Chetco Bar Fire before the Chetco Effect winds arrived in mid-August. Several of these stakeholders said if the Forest Service had used more aggressive firefighting strategies and tactics, the agency could have prevented the fire from getting as large as it did and threatening homes. Some of these officials and stakeholders raised concerns about whether incident management teams and line officers appropriately balanced the risks of different firefighting decisions during the fire. Some said the strategies and tactics taken early on may have put hundreds of firefighters and the public at risk later in the fire.

National forest and incident management team officials said that in attempting to suppress the Chetco Bar Fire, they adopted firefighting strategies and tactics that considered firefighter safety, the values at risk, and the probability of success. National forest officials said that when deciding how to respond to the fire, they prioritized firefighter safety and also considered the likelihood that a particular response would be

⁴⁷This is not a comprehensive list of all concerns raised about the Forest Service's response to the Chetco Bar Fire but captures key concerns raised by officials and stakeholders we interviewed.

successful, in accordance with 2017 Forest Service guidance.⁴⁸ As previously discussed, in the early stages of the Chetco Bar Fire, firefighters expressed concerns about their safety and the likelihood of success of certain tactics. In addition, national forest officials noted that after the rappellers asked to be pulled out of the fire and other firefighters expressed safety concerns, line officers were hesitant to send in additional firefighters. Other officials and stakeholders said the area where the Chetco Bar Fire started is very dangerous, with some noting that it is one of the most dangerous areas in the region and possibly the country to fight fire.

Specific concerns about the aggressiveness of the Forest Service's response included the following:

- **Number of firefighters.** Some officials and several stakeholders raised concerns about the Forest Service not sending in more firefighters at the beginning of the Chetco Bar Fire to try to contain it before it threatened homes. In response, national forest officials said that the four rappellers that were sent on the first day were part of an 18-person crew stationed near Grants Pass, Oregon. They were the only crew members available to respond on July 12, as the remaining crew members had just returned from another fire assignment, and firefighters are generally required to take 2 days off after completing a standard 14-day fire assignment.⁴⁹ As previously noted, safety concerns also factored into decisions to remove the rappellers and not add crews on the second day of the fire.
- **Absence of smokejumpers.** Some stakeholders raised concerns that the Forest Service did not send smokejumpers into the Chetco Bar Fire in its early stages, saying that smokejumpers may have been more effective at suppressing the fire when it was small.⁵⁰ In response, national forest officials said that the rappellers who were sent to the fire were located much closer to the ignition point than the

⁴⁸Specifically, the guidance states the agency must “implement strategies and tactics that commit responders only to operations where and when they can be successful, and under conditions where important values actually at risk are protected with the least exposure necessary while maintaining relationships with the people we serve. We expect that during such periods protecting lives of responders is the objective—we don’t expect and we won’t allow responders to risk their lives attempting the improbable.” Forest Service, *Chief’s Letter of Intent for Wildland Fire – 2017*.

⁴⁹Firefighters from the rappel crew had staggered their return from the previous fire assignment, so some crew members were available.

⁵⁰A smokejumper is a firefighter who parachutes into the site of a fire whereas a rappeller is a firefighter that rappels into the site of a fire via a rope attached to a helicopter.

closest smokejumpers and were able to respond more quickly. These officials also said that rappellers can be more effective in rough terrain with heavy timber, since they do not need an open space to land with parachutes and can be dropped closer to the fire.

- **Use of helicopters.** Several stakeholders raised concerns about the Forest Service stopping the use of helicopters to drop water on the fire after the rappellers were removed. According to interagency guidance and Forest Service officials, water drops are not as effective at containing a fire without crews on the ground (to build firelines, for example), and they did not want to expose helicopter crews to unnecessary risk for actions that were unlikely to be effective. In addition, officials said that the water drops were causing burning logs and other debris to roll down the hill and create spot fires. Interagency guidance discusses the importance of coordinating air and ground firefighting tactics, noting that the effectiveness of aircraft is dependent on the deployment of ground assets.⁵¹
- **Use of indirect strategies.** Several stakeholders raised concerns about incident management teams not engaging the fire more directly in the first several weeks rather than constructing fireline miles away. Some of these stakeholders described this indirect approach as a “watch and wait” or “let it burn” approach.⁵² In response, officials said that they looked for locations and opportunities to fight the fire directly, but the fire’s remote location and rugged terrain made this difficult. One official estimated it would have taken firefighters 2 days to hike to the fire because of the distance and trail conditions.
- **Number of burnout operations.** Several officials raised concerns about the Forest Service not conducting burnout operations before the Chetco Effect winds arrived in mid-August. However, as previously

⁵¹Specifically, interagency guidance states, “The effect of aviation resources [i.e., aviation assets] on a fire is directly proportional to the speed at which the resource(s) can initially engage the fire, the effective capacity of the aircraft, and the deployment of ground resources.” Department of the Interior and Department of Agriculture, National Interagency Fire Center, *Interagency Standards for Fire and Fire Aviation Operations*.

⁵²Some stakeholders also expressed concern over the Forest Service’s use of “minimum impact suppression tactics.” The intent of minimum impact suppression tactics is to suppress a fire while minimizing the long-term effects of the suppression action, according to National Wildfire Coordinating Group guidance. According to an incident decision from July 19, 2017, one action item was to “utilize minimum impact suppression within the Kalmiopsis Wilderness.” In addition, daily incident status summaries said the strategic objectives from July 15 through July 28 were “limited suppression confine and containment” of the Chetco Bar Fire.

noted, officials stated that there are risks in conducting such operations.

- **Limited use of chainsaws.** Some national forest officials raised concerns about limited use of chainsaws in the Kalmiopsis Wilderness, saying this prevented them from making quicker progress in constructing fireline.⁵³ For example, two national forest fire management officials said that in trying to clear a wilderness trail to use as a fireline, the crew used handsaws rather than chainsaws after the initial attack, which made the task more difficult and time consuming.⁵⁴
- **Limited action to protect homes.** Several stakeholders raised concerns about incident management teams not doing more to protect homes, stating that firefighters and equipment in the vicinity of homes that later burned were not used to help protect those homes. In response, national forest and headquarters officials said that although the agency tries to prevent fires from reaching homes, protecting homes and other private structures is the responsibility of state and local entities.⁵⁵ Moreover, headquarters officials noted that Forest Service firefighters are not trained or equipped to defend structures.

Forest Service officials said that since the Chetco Bar Fire, the agency has expanded tools that may help address some of these concerns for future fires. They noted that some of these tools were not widely available

⁵³As noted earlier, the Wilderness Act provides that, except as necessary to meet minimum requirements for the administration of a wilderness area, there shall be no use of motorized equipment within the area. 16 U.S.C. § 1133(c). Chainsaws were used in the Kalmiopsis Wilderness during the initial attack of the Chetco Bar Fire, according to Forest Service officials.

⁵⁴Chainsaw use was approved during the initial attack of the fire, as noted previously, but not again until the fire expanded rapidly in mid-August, according to some national forest officials. Another national forest official said that after the initial attack on the fire, firefighters did not formally request using chainsaws in the wilderness but he remembered discussing the topic with the line officer and other national forest officials and that chainsaw use was not approved. However, senior national forest officials said that they could not recall any instances during the Chetco Bar Fire when chainsaw use was requested and denied.

⁵⁵Interagency guidance states “fire suppression actions on structures that are outside federal jurisdiction, outside the scope of wildland firefighting training, or beyond the capability of wildland firefighting resources are not appropriate roles for the Forest Service.” See Department of the Interior and Department of Agriculture, National Interagency Fire Center, *Interagency Standards for Fire and Fire Aviation Operations*. Officials said that within this guidance, they are allowed to take limited steps to protect homes, such as clearing vegetation around structures or working with cooperators to lay sprinkler line.

at the time of the Chetco Bar Fire but are becoming more common. In particular, the Forest Service has an evolving risk management assistance program aimed at improving decision-making on fires by developing a strategic evaluation process. This program includes risk-management assistance teams that can be deployed to fires to assist with key decisions and exercises to help incident management teams and line officers analyze different firefighting options, according to program documents.⁵⁶ For example, the Forest Service developed a tradeoff analysis tool through which decision makers assess different firefighting options and rate them according to how well they address firefighter safety, public safety, and values at risk.⁵⁷ During the 2018 Klondike Fire, national forest officials said they brought in a risk-management team to facilitate analysis of firefighting options and included cooperators in the discussions. Officials said these discussions helped everyone understand the risks and tradeoffs of various firefighting options, adding transparency to the process.

Availability of Firefighting Assets

Several officials and stakeholders raised concerns about the number of firefighting assets assigned to the Chetco Bar Fire. According to Forest Service documents and officials, firefighting assets were stretched thin fighting other fires in the region, and there were a number of times throughout the Chetco Bar Fire when assets, such as management teams, crews, and helicopters, were requested but were unavailable (see table 1). For example, an incident management team that was heading to the Chetco Bar Fire was diverted to the Eagle Creek Fire, which was threatening homes and other structures near Portland, Oregon. Further, some officials said limited availability of certain firefighting assets with specific capabilities, such as infrared drones that can “see” through smoke or cloud cover, hindered their ability to fight the fire when visibility was limited. Some officials also emphasized the importance of having more long-term fire analysts assigned to national forests and incident management teams to help develop and interpret fire behavior models and long-term assessments that, in turn, could help protect people and

⁵⁶Risk-management assistance teams are small teams of three to four officials with expertise in fire operations and risk management led by an experienced line officer. During selected fires, these teams assist incident management teams and line officers in analyzing key decisions early on in fires.

⁵⁷According to a Forest Service document, these tradeoff analysis tools use a set of tables to provide a framework for assessing risk across (1) firefighter exposure, (2) public safety, and (3) values that may be affected by the fire (both positively and negatively). The three tradeoff elements are weighted and summarized to determine relative scores of firefighting courses of action, such as full containment of the fire or point protection, in which values at risk are protected without directly halting the continued spread of the fire.

values at risk. However, other officials said that having additional assets likely would not have made a significant difference in the response to the Chetco Bar Fire because of the difficult terrain where the fire started and because of the Chetco Effect winds.

Table 1: Number of Asset Requests That Could Not Be Filled during the Chetco Bar Fire, July through November 2017

Asset type	
Helicopters	6
Air tankers and other aircraft	8
Type-1 crews	10
Other crews	58
Engines	59
Other vehicles and equipment ^a	147
Total	288

Source: GAO analysis of information provided by the U.S. Forest Service. | GAO-20-424

^aOther vehicles and equipment include road graders, excavators, water tenders, forklifts, and mobile showers.

Beyond their specific concerns with the Chetco Bar Fire, some stakeholders also observed the Forest Service would likely benefit from having additional firefighting assets in the future, as the frequency and intensity of fires are likely to increase. Forest Service officials acknowledged that there were not enough firefighting assets in 2017, given the number of large fires that year. As a result, they said they had to make difficult decisions regarding prioritizing assets, with fires threatening life and property receiving higher priority.

Forest Service officials said that the agency is working to increase the number of some types of firefighting assets. For example, headquarters officials said that the agency was in the process of developing a drone program. In addition, officials said that the agency is working on increasing the availability of some assets, such as air tankers and helicopters, through the use of different contracting authorities.

Communication with Cooperators

Several officials and stakeholders raised concerns about communication among the various cooperators before and during the Chetco Bar Fire. In particular, some said that differences in firefighting approaches—due in part to cooperators’ differing missions, responsibilities, and priorities—had not been fully clarified in advance, leading some cooperators to express frustration with the Forest Service’s response to the fire. For example, according to some officials and stakeholders, the Oregon Department of

Forestry and Coos Forest Protective Association generally place more emphasis on protecting timberlands than the Forest Service, and this sometimes leads to differences in the agencies' preferred approaches to responding to fires. For example, when determining where to construct a fireline, Forest Service officials may identify a location aimed to keep a fire from reaching homes, whereas cooperators from the Oregon Department of Forestry or Coos Forest Protective Association may prefer a location that also protects timberlands.

In addition, some stakeholders said that the frequent rotation of incident management teams—generally about once every 2 weeks—made it difficult for local cooperators to coordinate with those teams. One official noted that rotation of teams can make it difficult to build trust and maintain good communication with cooperators and the public. However, Forest Service headquarters officials said that the agency has studied the structure and use of incident management teams in the past, and the agency has not identified a better approach.⁵⁸

Several officials and some stakeholders noted lessons learned from the Chetco Bar Fire. For example, they cited the need to do more pre-season fire planning, such as meeting with cooperators before the fire season begins to discuss coordination among agencies and planning how they might respond to fires in certain situations. Some also noted the need to improve communication and transparency with cooperators during fires, such as through the use of risk-management assistance teams previously discussed. Officials and stakeholders said that communication among cooperators in the region has improved since the Chetco Bar Fire, helping to develop a shared understanding of the potential firefighting response in different locations and under different conditions.⁵⁹

Communication with the Public

Many officials and several stakeholders said the Forest Service did not provide sufficient or timely information to the public about the danger from the Chetco Bar Fire and what the agency was doing to fight it. In particular, several officials raised concerns about the Forest Service

⁵⁸Officials said that fighting fires is exhausting—firefighters often work 14 to 16 hours per day when assigned to a fire—and that the rate of accidents is higher as firefighters spend more time on a fire assignment. Officials also said that most Forest Service incident management team members hold other positions and often need to return to their other duties. Firefighting assignments can be extended beyond 14 days in some cases, according to officials.

⁵⁹Rogue River-Siskiyou National Forest officials said they had pre-season meetings with cooperators in the past but there has been more involvement by cooperators since 2017.

waiting to hold its first public meeting until over a month after the fire was detected.⁶⁰ Several officials and some stakeholders said that in the absence of sufficient information, misinformation and rumors—such as incorrect information on evacuations in certain areas—spread, leading to frustration, anger, and fear on the part of the public. Officials and stakeholders said another lesson learned was the importance of communicating accurate and timely information through various means, including public meetings and social media.

Officials and stakeholders told us that the Rogue River-Siskiyou National Forest is taking steps to help ensure that it communicates more effectively during fires. For example, national forest officials said that since the Chetco Bar Fire, they have increased their level of communication with local communities. Officials also said they are now more proactive in monitoring social media and ensuring they post correct information on fires, among other things. As a result, officials and stakeholders said that public perception of the 2018 Klondike Fire was much more positive than of the Chetco Bar Fire, even though both fires burned more than 175,000 acres.

Timber Harvest and Other Fuel Reduction Activities

Several officials and stakeholders raised concerns about the amount of vegetation in the Rogue River-Siskiyou National Forest and the extent to which that vegetation fueled the Chetco Bar Fire. In particular, these officials and stakeholders were concerned that the level of timber harvest and fuel reduction activities—such as cutting down burned trees after past fires (referred to as salvage harvesting, see sidebar), thinning vegetation, or conducting prescribed burns—had been too low across the national forest.⁶¹ Some stakeholders raised concerns about the level of timber harvest being too low generally in southern Oregon, as well as the level of salvage harvesting done following past wildfires in that region. For example, some said that burned trees left after the 2002 Biscuit Fire

⁶⁰In early August, the Forest Service met with local cooperators to discuss the fire's progression and get their perspectives on the level of community interest in the incident, impacts to their agencies or organizations, and recommendations for conducting public meetings. At a cooperator meeting in Gold Beach on August 3, participants determined no public meetings were needed but would reassess this if fire conditions changed. The first public meetings were held on August 21 in Brookings and Gold Beach, after the fire expanded rapidly due to the Chetco Effect winds.

⁶¹For more information on federal fuel reduction activities, see [GAO-20-52](#).

Salvage Harvesting after the Chetco Bar Fire



Following wildfires, the Forest Service may consider whether to leave burned trees and allow the burned area to recover naturally or to harvest some of those trees—called salvage harvesting—with the intention of generating funds to help pay for the recovery of natural resources or infrastructure, such as trails or roads, among other purposes. Considerable scientific uncertainty exists about whether and how quickly harvested areas recover compared with unharvested areas. Disagreement also exists about the extent salvage harvesting generates funding, considering the cost of planning, preparing, and administering sales of salvaged trees.

Following the Chetco Bar Fire, the Forest Service determined that 13,626 acres of the burned area were potentially available for salvage harvesting. These areas had 50 to 100 percent tree mortality and were in areas of the Rogue River-Siskiyou National Forest where timber harvesting aligned with existing management objectives, according to an official. The Forest Service narrowed the area that it proposed putting up for salvage harvesting to 4,090 acres, removing areas that lacked economically viable timber, were inaccessible to logging equipment, were in roadless areas, or had sensitive wildlife habitat, among other factors. The total number of acres the Forest Service offered for salvage harvesting was 2,194 acres across 13 sales, according to an official. Of the 13 salvage sales offered, eight were sold, totaling 1,957 acres, and five were not sold. Of these five offers, three did not receive bids, and two were dropped by the Forest Service due to market changes or other considerations.

Source: GAO analysis of information from U.S. Forest Service documents and officials (text) and GAO (photo). | GAO-20-424

fueled the Chetco Bar Fire and made firefighting efforts more dangerous by leaving snags (standing dead trees) that could injure or kill firefighters.⁶²

In contrast, several Forest Service officials and some stakeholders said that higher levels of timber harvest and fuel reduction would not have made a large difference in the Chetco Bar Fire because of the fire's intensity and rate of spread under the Chetco Effect winds. Several said that if there had been more timber harvest, the forest might have been replanted in ways that could have made the fire worse. Specifically, when replanting is done following timber harvest, trees may be planted more densely and uniformly than would occur if vegetation were allowed to grow back naturally, according to a Forest Service ecologist and some stakeholders. In addition, slash (debris from logging operations) is sometimes left on the ground after timber harvest, which can fuel future fires. As a result, areas where timber has been harvested may burn more severely during future fires, according to some officials and stakeholders.

⁶²We previously reported on the Forest Service's salvage sales and other recovery efforts following the Biscuit Fire. See [GAO-06-967](#).

Rogue River-Siskiyou National Forest officials said the forest has been carrying out many fuel reduction activities and has exceeded its fuel reduction target every year from fiscal year 2014 through fiscal year 2019 (see appendix I for a map of past timber harvests and other fuel reduction activities).⁶³ As part of its fuel reduction efforts, the forest is creating some larger breaks in vegetation by connecting areas where fuel reduction activities have taken place, according to officials. Further, national forest officials are maintaining some firelines that were built during previous fires, including the Chetco Bar Fire, to aid in their response to future fires. Agency officials said these efforts are part of a broader effort to move towards spatial fire planning, where areas at risk and effective places to contain wildfires are identified before fires start.⁶⁴

Chetco Bar Fire Had Various Effects on Homes and Infrastructure, Public Health, Local Businesses and Workers, and Natural and Cultural Resources

Forest Service officials and stakeholders we interviewed and reports and other documents we reviewed identified a variety of effects the Chetco Bar Fire had on local communities and resources. We grouped these effects into four categories: (1) homes and infrastructure, (2) public health, (3) local businesses and workers, and (4) natural and cultural resources.⁶⁵ Most of the identified effects were negative, although some positive short- and long-term effects were identified. For example, the Chetco Bar Fire damaged habitat for many wildlife species, but some species that prefer burned landscapes likely benefitted from the fire, according to officials.

⁶³According to Forest Service documents and officials, for fiscal year 2019, the Rogue River-Siskiyou National Forest conducted fuel reduction activities on 6,532 acres and its target was 6,500 acres.

⁶⁴Under this approach, potential locations to control a fire are identified before fires begin by analyzing maps and other information to identify areas that have been effective at containing fires in the past. This information is used along with maps showing values at risk, such as homes and private timberlands, to determine the best areas to engage a fire, build firelines, or conduct fuel reduction activities to protect such values.

⁶⁵This is not a comprehensive list of all effects of the Chetco Bar Fire but captures key effects identified by officials and stakeholders we interviewed and in documents we reviewed.

Effects on Homes and Infrastructure

Soil Erosion after Wildfires



After a severe wildfire, soil erosion can increase and cause adverse effects. As fires burn, they destroy plant material, such as roots and leaves, that help prevent erosion during severe rainstorms. Plant roots help stabilize the soil, and leaves slow runoff by allowing water to seep into the soil. In some severe fires, burning vegetation creates a gas that penetrates the soil. As the soil cools, this gas condenses and forms a waxy coating that causes the soil to repel water. Rainwater and melted snow can then flow across these surfaces and cause erosion. Erosion can reduce water quality and damage roads. In addition, because burned soil does not absorb as much water as unburned soil, seeds have a harder time germinating, and surviving plants find it more difficult to obtain moisture.

Source: GAO analysis of U.S. Forest Service information (text) and U.S. Forest Service (photo). | GAO-20-424

The Chetco Bar Fire destroyed six homes and damaged one home, according to Forest Service and state documents.⁶⁶ The fire also threatened over 8,500 homes, causing more than 5,000 residents to be evacuated over the course of the fire, according to Forest Service documents. In addition, Forest Service and state documents stated that the fire destroyed more than 20 other structures and damaged at least eight more, such as garages and other outbuildings.⁶⁷

The fire also damaged infrastructure in the Rogue River-Siskiyou National Forest and in or near Brookings, Oregon, according to Forest Service documents. For example, the Forest Service's BAER report noted that post-fire erosion damaged some roads and trails within the fire perimeter, and other roads and trails remained at risk from future rainstorms (see sidebar and fig. 9).⁶⁸ Following the fire, the Forest Service improved culverts and other drainage features and took other steps to help protect 136 miles of roads. In addition, the Forest Service improved drainage features to help protect approximately 18 miles of damaged trails out of

⁶⁶Forest Service, *Incident Status Summary, (ICS-209)* (Nov. 2, 2017); and Oregon Office of the State Fire Marshal, Coos Forest Patrol, and Pacific Northwest Incident Management Team, *Chetco Bar Damage Inspection Report*.

⁶⁷The Chetco Bar Fire also destroyed at least 13 vehicles.

⁶⁸Forest Service, *Chetco Bar Burned Area Emergency Response Initial Authorization*. The BAER report identified immediate and emergency actions needed to address post-fire risks to people, property, cultural and natural resources on national forest land caused by the post-fire conditions and recommended emergency treatments. The Forest Service temporarily closed some roads and areas within the Rogue River-Siskiyou National Forest during and after the Chetco Bar Fire because of safety concerns, according to Forest Service documents and officials.

the 63 miles of trails within the fire perimeter.⁶⁹ Further, a campground within the national forest was partially damaged and closed to the public while being repaired.

Figure 9: Culvert and Road Damaged by Erosion following the Chetco Bar Fire, October 2017



Source: U.S. Forest Service. | GAO-20-424

Erosion following the Chetco Bar Fire also washed approximately 40,000 cubic yards of sediment into the Port of Brookings Harbor. A port official said that dredging the harbor is estimated to cost \$4 million. The official noted that the commission governing the port was pursuing grants, such as disaster grants from the Federal Emergency Management Agency, to help with dredging costs but was unsure whether total costs could be covered.

Local officials said that post-fire erosion could also negatively affect drinking water infrastructure, since the Chetco Bar Fire burned about 80 percent of Brookings' watershed.⁷⁰ Brookings received a grant to evaluate the fire's effect on the city's water system, according to a local official. The city hired a consultant, who reported in June 2018 that the

⁶⁹Trails were also damaged when trees killed by the fire fell across trails and impeded access.

⁷⁰The BAER report identified the potential for immediate and long-term effects on water quality. Forest Service, *Chetco Bar Burned Area Emergency Response Initial Authorization*.

quality of the water was generally excellent and that no significant water quality effects from the fire had been observed.⁷¹

Effects on Public Health

Particulate Matter

Particulate matter comes from many different sources, including power plants, industrial processes, vehicle tailpipes, woodstoves, and wildfires. Because fine particulate matter is small in size (2.5 micrometers or less in diameter), it can be inhaled deep into the lungs and cause or aggravate a number of serious health effects. Particulate matter has been linked to illnesses such as heart and lung disease, and even death. In older adults and those with heart or lung disease, these effects have been associated with both short-term exposure (hours or days) and long-term exposure (years).

Effects include:

- People with existing heart disease may experience chest pain, palpitations, shortness of breath, and fatigue. Particulate matter has also been associated with cardiac arrhythmias and heart attacks.
- People with existing lung disease may not be able to breathe as deeply or vigorously as they normally would during exposure to high levels of particulate matter. Healthy people may also experience these effects.
- Particulate matter may increase susceptibility to respiratory infections and aggravate existing respiratory diseases, such as asthma and chronic bronchitis.

Source: GAO analysis of an Environmental Protection Agency document. | GAO-20-424

People near the Chetco Bar Fire experienced negative health effects, including respiratory problems and mental and emotional effects. The respiratory problems stemmed from poor air quality caused by smoke from multiple wildfires in 2017, although those effects have not been quantified, according to local health officials.⁷² Forest Service documents noted that at times during the Chetco Bar Fire, more than 30 other fires were burning in the region and, as a result, not all smoke could be attributed to the Chetco Bar Fire. The Oregon Health Authority identified fine particulate matter as the primary threat to public health from wildfire

⁷¹GSI Water Solutions, Inc., *Findings and Recommendations for Water System Response and Protection Plan Following the Chetco Bar Fire – FINAL* (Bend, OR: June 8, 2018).

⁷²A Forest Service scientist developed preliminary estimates on emissions of certain pollutants, such as particulate matter and formaldehyde, from the Chetco Bar Fire, as well as the amount of carbon dioxide released during the fire but did not estimate net carbon emissions over the long term (the amount of additional carbon that could be sequestered in the burned area due to regrowth). In many cases, net carbon emissions from wildfires over the long term may be negligible when accounting for carbon sequestration due to regeneration and other factors, according to another Forest Service scientist.

smoke (see sidebar).⁷³ Most healthy individuals recover quickly from smoke exposure and will not experience long-term health effects, according to an Environmental Protection Agency document; however, the smoke exposure effects are more sudden and serious for sensitive groups, including children, older adults, and people with existing heart or lung disease.⁷⁴ Local health officials and a national forest official also raised concerns about the potential long-term effects of exposure to wildfire smoke, but little data exist on such effects.⁷⁵

The Forest Service reported that four towns in the vicinity of the Chetco Bar Fire experienced, on average, about 9 days of unhealthy or worse air quality, although the severity and duration of wildfire effects on air quality varied by town (see fig. 10).⁷⁶ Of these towns, Brookings had the most days—three—measured as “hazardous,” the worst category. The four towns also experienced about 5 days, on average, that were measured as being unhealthy for sensitive groups.⁷⁷

⁷³The Oregon Health Authority cited a general increase in hospital admissions related to respiratory and cardiovascular conditions in Coos, Curry, Jackson, and Josephine counties during the height of the Chetco Bar Fire and later. Oregon Health Authority, Oregon State Public Health Division, *2017 Oregon Chetco Bar Fire Air Quality and Health Outcomes* (Portland, OR: Sept. 20, 2019).

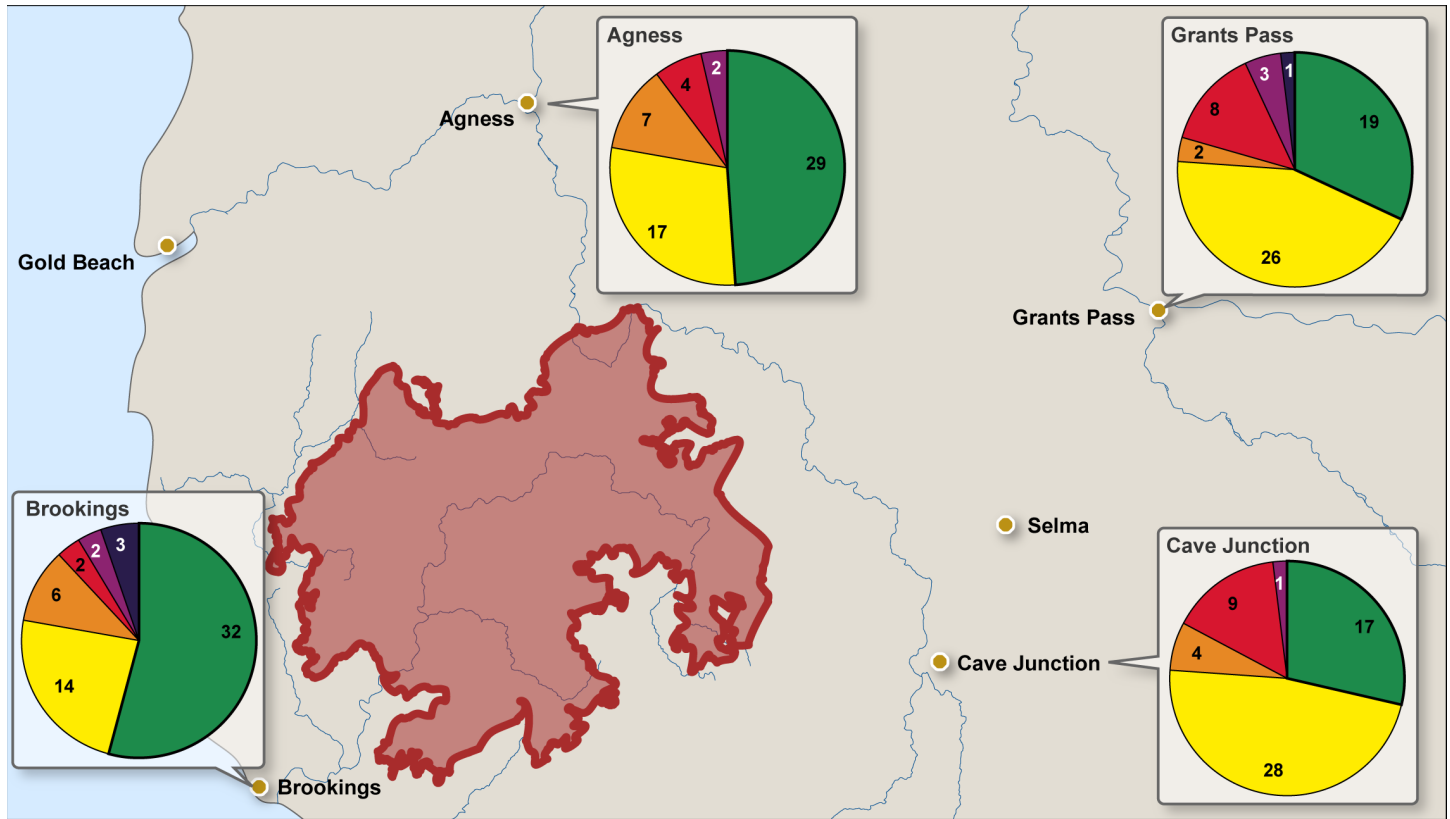
⁷⁴Environmental Protection Agency, *Wildfire Smoke: A Guide for Public Health Officials, Revised 2019* (Washington, D.C.: August 2019). Increased risk of heart attacks from particulate matter may begin as early as the mid-40s for men and mid-50s for women, according to another Environmental Protection Agency document.

⁷⁵C. Black, Y. Tesfaigzi, J.A. Bassein, and L.A. Miller, “Wildfire Smoke Exposure and Human Health: Significant Gaps in Research for a Growing Public Health Issue,” *Environmental Toxicology and Pharmacology*, vol. 55 (2017): pp. 186-195.

⁷⁶Four of the towns that the Forest Service monitored and reported daily air quality index data were Agness, Brookings, Cave Junction, and Grants Pass. The air quality index has six levels, corresponding to different levels of health concern: good, moderate, unhealthy, unhealthy for sensitive groups, very unhealthy, and hazardous. As the air quality deteriorates, the index level and health concerns increase. For example, air quality at a “good” level poses little or no health risk, but air quality at very unhealthy and hazardous levels can pose serious health effects to the entire population.

⁷⁷From 2012 through 2016, 45 percent of Brookings’ population consisted of sensitive groups of children under 17 and adults over 65 years old. ECONorthwest, *The Chetco Bar Fire: Economic Impacts and Opportunities*.

Figure 10: The Number of Days at Each Air Quality Index Level for Four Oregon Towns Near the Chetco Bar Fire from July 28 through September 26, 2017



Final Chetco Bar Fire perimeter (approximate)

- Air Quality Index**
- Hazardous
 - Very unhealthy
 - Unhealthy
 - Unhealthy for sensitive groups
 - Moderate
 - Good

0 10
miles

Source: GAO analysis of U.S. Forest Service documents. | GAO-20-424

Note: Air quality data were unavailable for September 4 and 13, 2017.

Many residents also experienced mental and emotional effects from the Chetco Bar Fire, according to local health officials and some stakeholders.⁷⁸ A local health official said that some residents experienced post-traumatic stress disorder after the fire, with some residents becoming hypervigilant of smoke and sirens. Some stakeholders noted that the 2018 Klondike Fire, which burned nearby, led to additional mental and emotional stresses for those affected by the Chetco Bar Fire.

Effects on Local Businesses and Workers

The Chetco Bar Fire's effects on local businesses and workers included damage to the tourism and logging industries. Local businesses lost revenue in the short term because of decreased summer tourism during the Chetco Bar Fire, according to some documents and many stakeholders.⁷⁹ According to estimates from the Oregon Tourism Commission, businesses—including tourism-dependent ones such as hotels and restaurants—lost over \$1 million in both Curry and Jackson counties, and businesses in Josephine County lost over \$160,000 during the 2017 fire season.⁸⁰ For example, the Oregon Shakespeare Festival canceled nine outdoor performances because of wildfire smoke, resulting in losses estimated at about \$600,000, according to a company document.⁸¹ In addition, one vineyard in Cave Junction lost an estimated \$10,000 to \$20,000 in revenue because of reduced tasting room sales and vacation rentals, according to an Oregon vineyard association spokesperson.⁸²

The decrease in tourism also had short-term negative effects on workers in the tourism industry. According to a report, workers in Curry County

⁷⁸The Oregon Health Authority did not have data on mental and emotional effects from the fire, as officials noted that such effects are hard to quantify.

⁷⁹Some hotel, food, and other service businesses may have received some benefit from money spent by first responders during the fire. However, one report we reviewed noted that such gains only minimally offset the losses of local businesses. ECONorthwest, *The Chetco Bar Fire: Economic Impacts and Opportunities*.

⁸⁰Oregon Tourism Commission, *The Impacts of the 2017 Wildfires on Oregon's Travel and Tourism Industry*. Tourism is a major driver of the economy in Brookings and other parts of southern Oregon, according to the Chetco Bar Fire Recovery Council.

⁸¹The Oregon Shakespeare Festival in Ashland, Oregon, produces almost 800 plays for a total of approximately 400,000 audience members each year.

⁸²Some stakeholders also said that wildfire smoke "tainted" the flavor of some grapes grown in the area. However, one vineyard owner noted no effect on wine or grape quality following the Chetco Bar Fire.

lost income, in part due to employee furloughs, because of wildfires in 2017.⁸³ Another document cited that Josephine County lost an estimated 100 jobs in 2017 because of the Chetco Bar Fire.⁸⁴

Following the fire, the governor of Oregon created the Chetco Bar Fire Recovery Council to help the region recover from the fire. The council assessed economic damage, identified recovery needs, and identified potential state funding for those needs.⁸⁵ For example, in November 2017, the council identified a potential need for state economic development funds to assist local businesses. However, the council reported in March 2018 that three businesses affected by the fire had received federal loans from the U.S. Small Business Administration and that there was no longer a clear need for state economic development funds.

In addition, some stakeholders we interviewed and documents we reviewed raised concerns that if summer wildfire smoke became common in southern Oregon, it could have a long-term negative effect on tourism. However, a 2019 report found that wildfire smoke had a minimal effect on people's willingness to consider traveling to southern Oregon in the future.⁸⁶ One local business has set up air quality monitors at a tourist attraction to inform tourists of the current air quality.

The Chetco Bar Fire burned 14,130 acres of nonfederal timberlands, according to the Forest Service's BAER report.⁸⁷ One privately owned lumber company was particularly hard hit, with the fire burning about 10,000 acres of its timberlands, according to company representatives.

⁸³Approximately 20 percent of employment in Curry County is tourism dependent. Oregon Tourism Commission, *The Impacts of the 2017 Wildfires on Oregon's Travel and Tourism Industry*. However, the Oregon Employment Department noted that since the fire coincided with the typical end of the tourism season, it was unclear which jobs were lost due to the fire and which were cut as the tourism season ended.

⁸⁴The Chetco Bar Fire Recovery Council, *Initial Findings of Needs and Impacts from Chetco Bar Fire* (Nov. 22, 2017). Total employment in Josephine County was about 23,500 in 2017, according to the U.S. Census Bureau.

⁸⁵Other recommendations the council identified related to stream bank and trail restoration and timber harvest.

⁸⁶Southern Oregon University Research Center, *Southern Oregon Wildfire and Visitor Perception Study* (Ashland, OR: April 2019).

⁸⁷Forest Service, *Chetco Bar Burned Area Emergency Response Initial Authorization*.

This loss was about 10 percent of the company's timberlands and represented about 5 years of its average harvest.

Following the fire, the company salvage-harvested approximately 6,000 acres of the burned timber, which company representatives said provided some short-term economic benefits for the company and, according to one stakeholder, also temporarily increased employment for loggers and truck drivers in the area. However, the long-term effects of the fire on the company are unknown. One representative said, depending on future market conditions, the loss of timber from the Chetco Bar Fire could lead the company to lay off employees or could jeopardize its future.

Effects on Natural and Cultural Resources

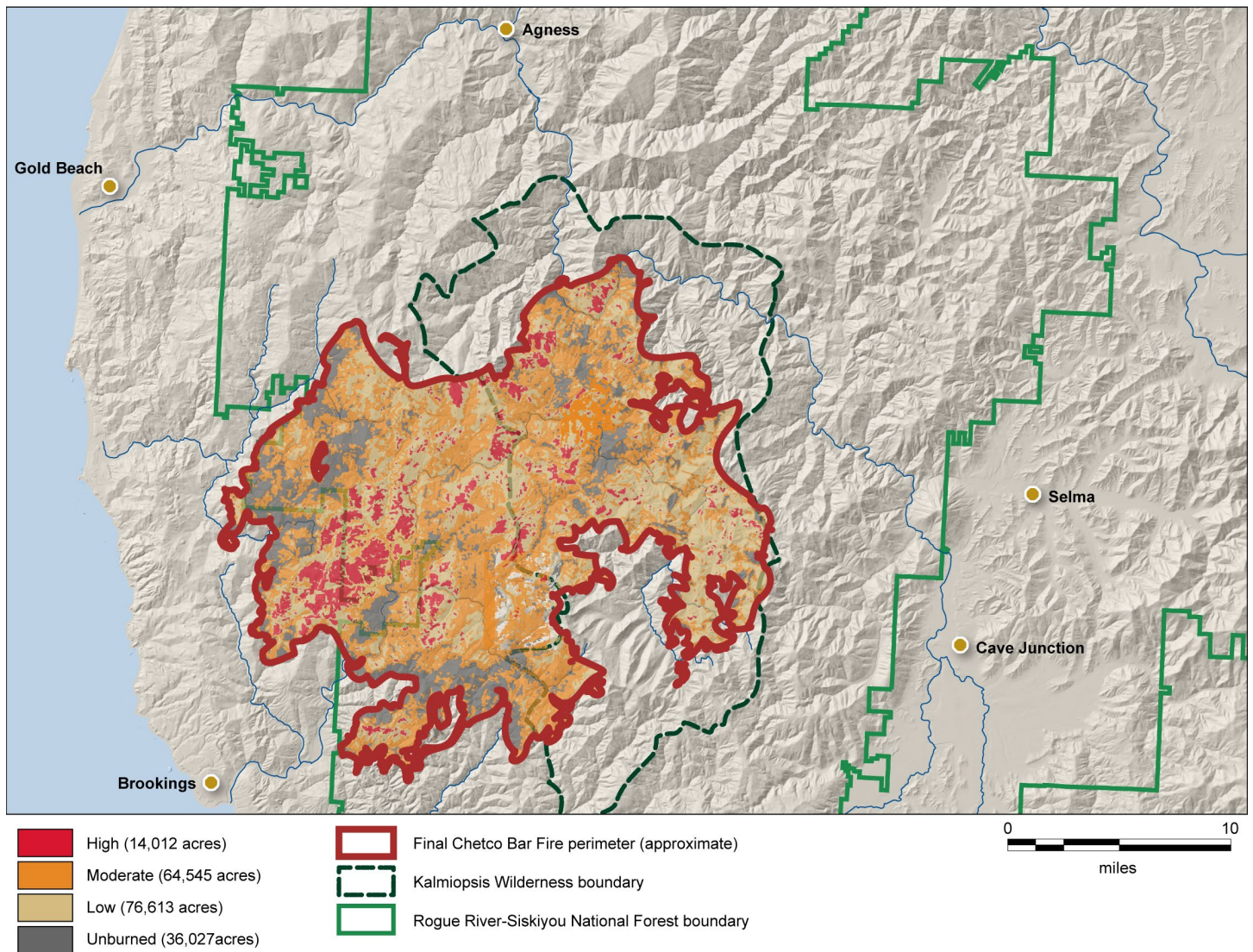
Soil and Vegetation

The severity of the Chetco Bar Fire varied across the forest, which led to varied effects on soil and vegetation. As shown in figure 11, within the perimeter of the Chetco Bar Fire, burn severity ranged as follows:

- unburned or very low (19 percent, or 36,027 acres);
- low (40 percent, or 76,613 acres);
- moderate (34 percent, or 64,545 acres); and
- high (7 percent, or 14,012 acres).⁸⁸

⁸⁸Forest Service, *Chetco Bar Burned Area Emergency Response Initial Authorization*.

Figure 11: Soil Burn Severity from the Chetco Bar Fire, 2017



Source: GAO analysis of U.S. Forest Service information; U.S. Forest Service (map). | GAO-20-424

The severity with which soil burns during a fire affects both the potential for erosion following the fire and the severity of damage to vegetation. Areas of the Chetco Bar Fire that burned at moderate and high severity had increased potential for erosion, according to the BAER report. As previously discussed, post-fire erosion damaged roads and other infrastructure. Further, the BAER report noted that severely burned areas

may have lower soil productivity and vegetation growth. However, most of the native vegetation in the area is adapted to fire and is likely to recover over time, according to the BAER report.⁸⁹ Moreover, a Forest Service ecologist said the Chetco Bar Fire helped create a more diverse forest structure (characterized as a mosaic of different species and age classes) that benefits many plant and animal species (see fig. 12). For example, nine sensitive plant species found in the area burned by the Chetco Bar Fire thrive in early post-fire ecosystems, according to a Forest Service document.⁹⁰ Further, officials said rapid regrowth of vegetation, such as a moss that thrives after fires, helped reduce erosion and limit potential future damage to roads and trails.

Figure 12: Burn Mosaic (Burned and Unburned Trees) Produced by the Chetco Bar Fire, 2017



Source: U.S. Forest Service. | GAO-20-424

⁸⁹Parts of the Rogue River-Siskiyou National Forest provide habitat for an endangered plant species—*Arabis macdonaldiana* (McDonald's rockcress)—but the habitat for this species burned with low severity and was not affected by suppression activities, according to the BAER report.

⁹⁰The nine sensitive plant species are Howell's manzanita, goldenfleece, stickseed, Baker's cypress, California globe mallow, lemmon's beardtongue, balsam bird's foot trefoil, redberry, and western sophora.

Forest Service officials and documents noted that they did not expect widespread, long-term negative effects on vegetation from the Chetco Bar Fire, but they identified two negative effects:

- **Invasive plants.** More than a thousand individual invasive plants (such as noxious weeds) were introduced to an approximately 13,000-acre area of the national forest during the Chetco Bar Fire, mainly via firefighters' boots and equipment. Invasive plants can, in some cases, displace native plants, compromise the quality and quantity of habitat for wildlife and fish, and increase wildfire risk.⁹¹ A national forest official said that it is labor intensive and costly to eradicate invasive plants because they have to be pulled out by hand. The official said the agency does not have the resources to remove all of the invasive plants brought in during the fire and is prioritizing removal of those that are the fastest growing, most disruptive, and affect the most highly valued resources. In addition, the National Forest Foundation administered a \$7,000 grant to remove invasive plants on 10 of the affected acres in June and July 2019.⁹²
- **Redwood stands.** The Rogue River-Siskiyou National Forest contains the northernmost naturally occurring coast redwood tree stands, and the Chetco Bar Fire burned about 12 percent of the total area of redwood stands within the forest, or about 60 acres, according to a Forest Service ecologist. However, most of the area burned at low severity, though parts burned at moderate or high severity. The ecologist said redwoods are adapted to survive fire, noting that larger trees will usually resprout from dormant buds under the bark along the entire length of the trunk (see fig. 13). Smaller trees and larger trees burned at high severity can be killed at the top but are often able to resprout.

⁹¹Asher, J., Dewey, S., Johnson, C., Olivarez, J. "Reducing the spread of invasive exotic plants following fire in western forests, deserts, and grasslands." Galley, K.E.M., Wilson, T.P. (Eds.), *Proceedings of the Invasive Species Workshop: The Role of Fire in the Control and Spread of Invasive Species*, Fire Conference 2000: The First National Congress on Fire Ecology, Prevention, and Management. Misc. Pub. No. 11. Tall Timbers Research Station, Tallahassee, FL, 2001, pp. 102–103.

⁹²The National Forest Foundation is a congressionally chartered organization that accepts donations for the benefit of Forest Service activities and services.

Figure 13: New Growth on Redwoods Burned by the Chetco Bar Fire, June 2019



Source: GAO. | GAO-20-424

Wildlife

In the short-term, the Chetco Bar Fire killed or damaged habitat for many wildlife species, although the exact effect of the fire on wildlife is unknown, according to a Forest Service official. Most wildlife species are expected to recover, but the effects on some threatened and sensitive species could be longer lasting, according to Forest Service documents and officials. For example, half of the 13 known northern spotted owls—a species that is federally listed as threatened under the Endangered Species Act—living within the perimeter of the fire were estimated to have died from the fire, according to a Forest Service biologist.⁹³ In addition, this biologist said the fire's effect on the population of a seabird called the

⁹³The northern spotted owl is a nocturnal predator that nests in the tops of trees in forests in southwestern British Columbia, western Washington and Oregon, and northwestern California.

marbled murrelet,⁹⁴ as well as on two mammals—Pacific marten and fisher⁹⁵—is unknown, although it negatively affected their habitats.

National forest officials said the Chetco Bar Fire also likely benefitted some wildlife species because the mosaic landscape resulting from the fire is preferred by some wildlife, including deer, elk, migratory birds, butterflies, and woodpeckers. For example, black-backed woodpeckers thrive in partly burned areas because they eat wood-boring beetles that feed on recently burned trees.

Fish

Erosion resulting from the Chetco Bar Fire likely had short-term negative effects on fish populations, including the threatened coho salmon, according to the BAER report. Sediment in the water makes it harder for fish to breathe and can smother their eggs. In addition, over time, increased sediment in streams and rivers can disrupt salmon migration because salmon use their sense of smell to navigate to their native stream to spawn, and sediment can mask that smell. Some stakeholders said they were concerned that the loss of shade from trees might lead to warmer river water, thereby harming salmon. However, a Forest Service biologist said that vegetation near the river has regrown since the fire and there is no indication that the temperature of the river water has increased.

The fire may provide some long-term benefits for salmon and other fish species. Specifically, erosion following the fire is likely to increase the supply of downed trees and coarse gravel in streams and rivers, which provide places for fish to lay their eggs and hide, according to a study and a Forest Service biologist.⁹⁶

Cultural Resources

Some cultural resources—including archaeological sites, historic structures, and areas significant to contemporary Native American

⁹⁴The marbled murrelet is a seabird that spends the majority of its life on the ocean but nests in old-growth forests. It is listed under the federal Endangered Species Act as threatened in Washington, Oregon, and California, and state-listed as endangered in California and as threatened in Oregon and Washington.

⁹⁵The Pacific marten and fisher are both members of the weasel family. The U.S. Fish and Wildlife Service proposed listing the coastal distinct population segment of the Pacific marten and the west coast population of fisher as threatened species under the Endangered Species Act in October 2018 and November 2019, respectively.

⁹⁶Benda, L.E., Falk, J.A., Flitcoft, R.L., Hessburg, P.F., McNyset, K.M., Reeves, G.H., "Wildfire may increase habitat quality for spring Chinook Salmon in Wenatchee River subbasin, WA, USA," in *Forest Ecology Management*, vol. 359 (2016): pp.126-140.

tribes—were negatively affected by the Chetco Bar Fire.⁹⁷ The Forest Service reported that 130 known and recorded Native American archaeological sites were located within the perimeter of the Chetco Bar Fire, 49 of which the agency characterized as isolated sites containing one to three stone artifacts.⁹⁸ The effect of the Chetco Bar Fire on known and recorded sites—and on any cultural sites not previously identified—is not fully known. Following the fire, as part of its BAER report, the Forest Service assessed some of these sites, including a prehistoric Native American village site and an area culturally important to Native American tribes. This report noted a number of cultural artifacts, such as arrowheads and tools, that were discolored by the fire or were displaced or moved during or after the fire by, for example, soil disruption caused by trees falling or roots burning and collapsing. The report also stated additional damage could occur in the future; for example, increased erosion could further damage some cultural sites, and vegetation loss could make artifacts more visible, increasing the potential for looting and vandalism. To help mitigate some of the effects, the Forest Service planted some of the burned area with native grass seed to reestablish ground cover and reduce erosion.

In addition to the fire damaging cultural resources, a Forest Service archaeologist said fire suppression activities caused some damage. For example, Native American arrowheads and tools were unearthed when a bulldozer constructed a fireline. The archeologist said that they took precautions to minimize suppression impacts on cultural resources, for instance by avoiding using heavy equipment in areas where cultural resources were known to be located.

Agency Comments

We provided a draft of this report to the Departments of Agriculture and the Interior for review and comment. In an email dated April 17, 2020, the Forest Service, responding on behalf of the Department of Agriculture, said it generally agreed with the draft report. The Forest Service also provided a technical comment, which we incorporated. The Department of the Interior told us it had no comments on the report.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the

⁹⁷Cultural resources include any site, building, structure, object or area that has value in history, archeology, architecture, engineering or culture.

⁹⁸Forest Service, *Chetco Bar Wildfire BAER Resource Report* (Oct. 10, 2017).

report date. At that time, we will send copies to the appropriate congressional committees, the Secretary of Agriculture, the Secretary of the Interior, and other interested parties. In addition, the report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or fennella@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix II.

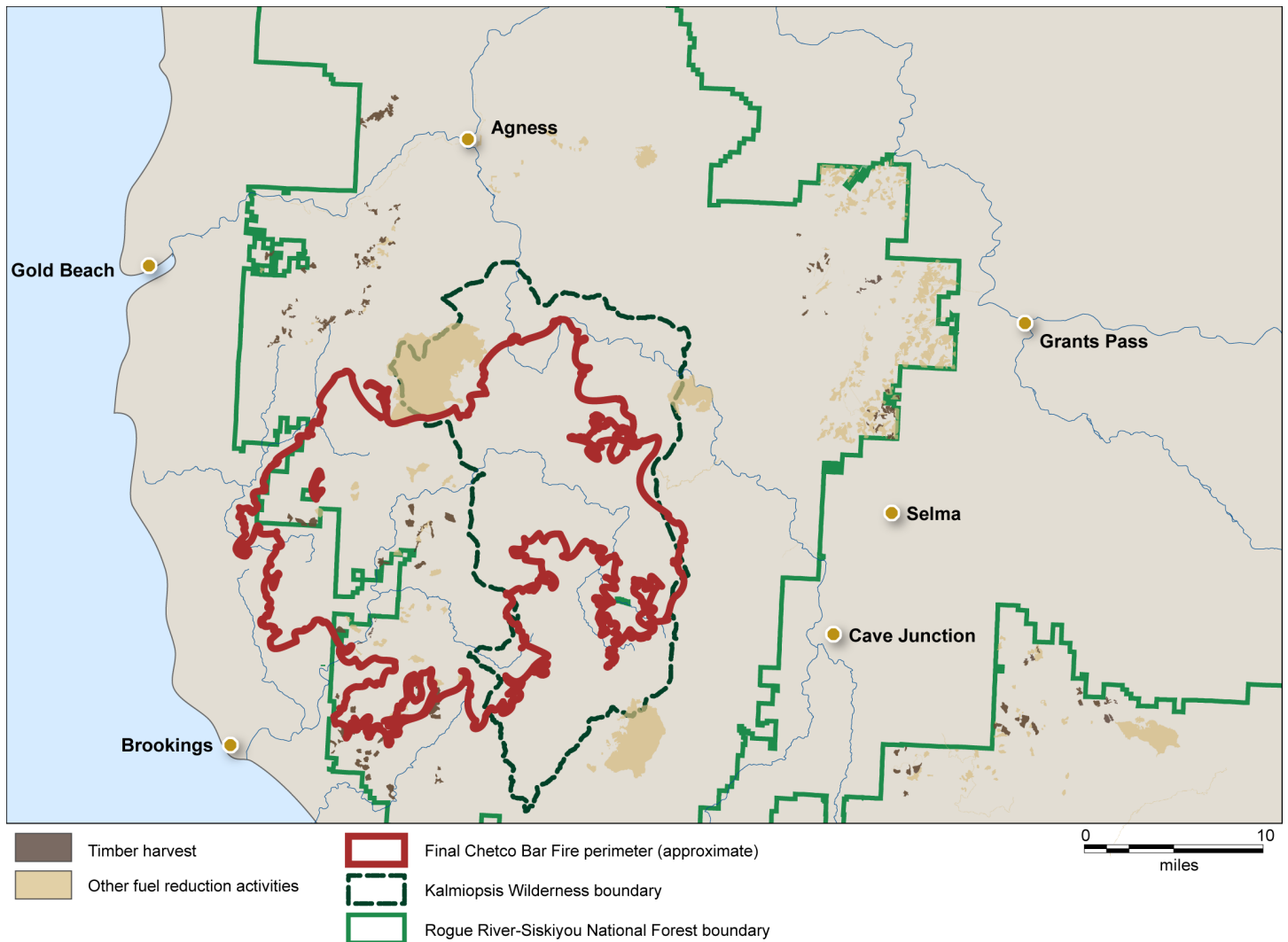


Anne-Marie Fennell
Director, Natural Resources and Environment

Appendix I: Map of Timber Harvests and Other Fuel Reduction Activities in the Area of the Chetco Bar Fire

Figure 14 shows the timber harvests and other fuel reduction activities—such as thinning vegetation or conducting prescribed burns—done in the area of the Chetco Bar Fire from 2008 through 2017.

Figure 14: Map of Timber Harvests and Other Fuel Reduction Activities in the Area of the Chetco Bar Fire, 2008 through 2017



Source: GAO analysis of U.S. Forest Service documents. | GAO-20-424

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Anne-Marie Fennell, (202) 512-3841 or fennella@gao.gov

Staff Acknowledgments

In addition to the individual named above, Jonathan Dent (Assistant Director), Lesley Rinner (Analyst-in-Charge), Elizabeth Jimenez, and Jesse Lamarre-Vincent made key contributions to this report. Philip Farah, Ellen Fried, Richard P. Johnson, John Mingus, Edward J. Rice, Sara Sullivan, and Elizabeth Wood made additional contributions.

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