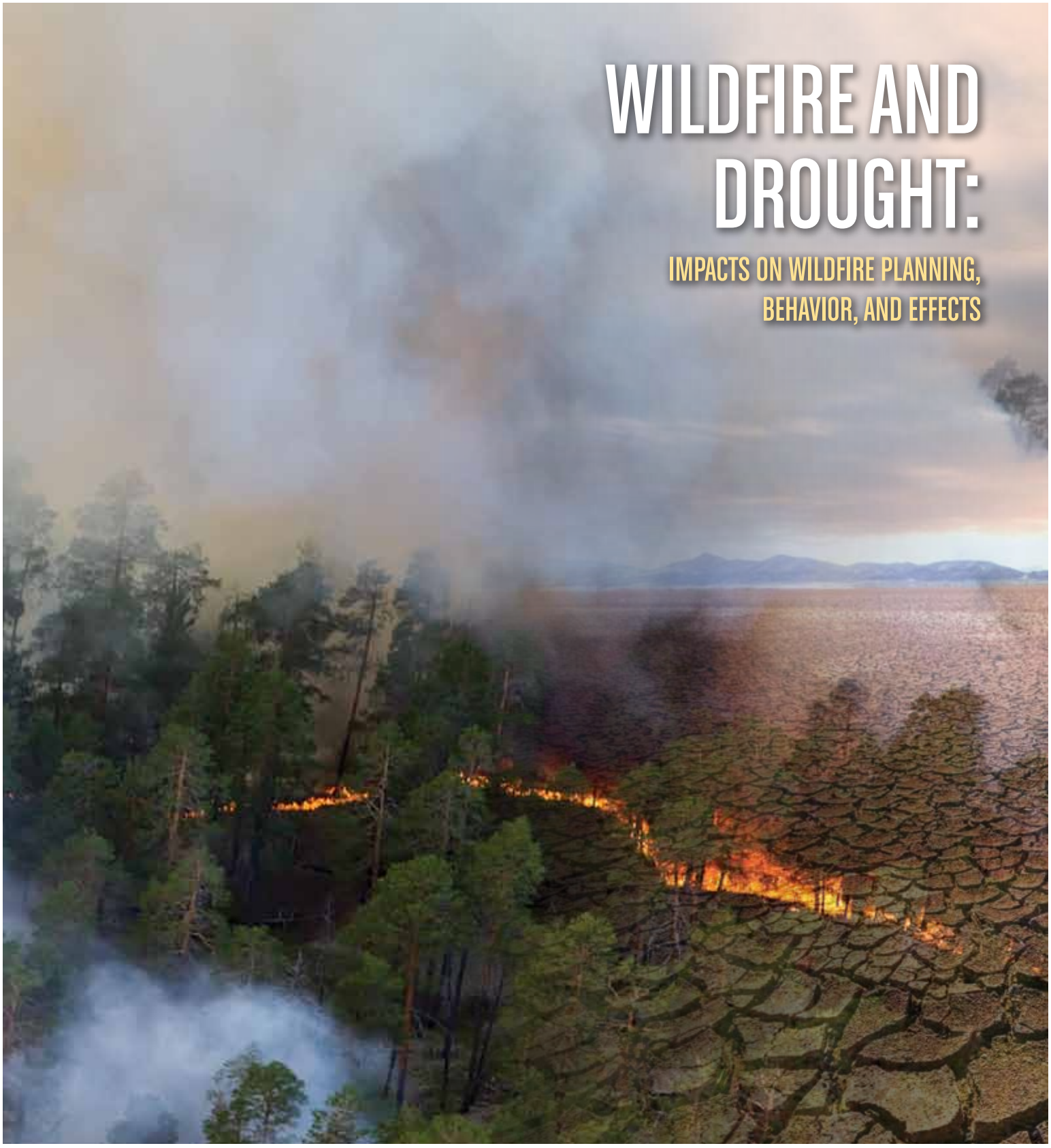
WILDFIRE AND DROUGHT:

IMPACTS ON WILDFIRE PLANNING, BEHAVIOR, AND EFFECTS



NOAA

NIDIS

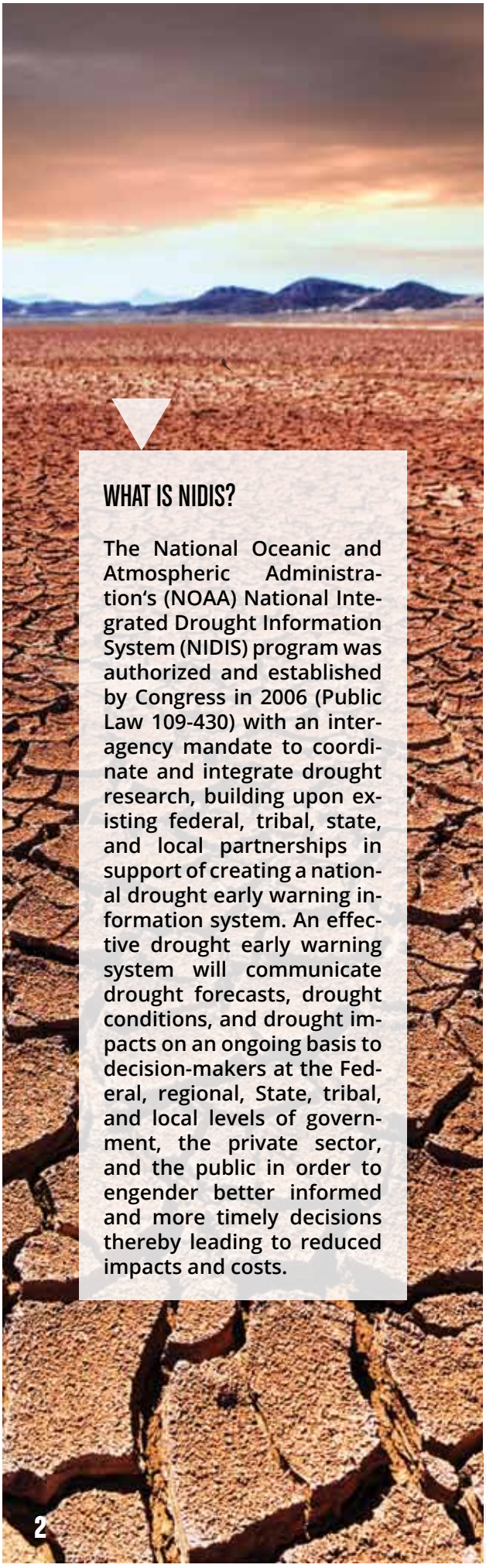
CNAP
California-Nevada Climate Applications Program

CEFA
Climate
Ecosystem
Fire / Applications

DRI
Desert Research Institute

Western Regional
Climate Center
Providing climate services since 1986

National Drought Mitigation Center



WHAT IS NIDIS?

The National Oceanic and Atmospheric Administration's (NOAA) National Integrated Drought Information System (NIDIS) program was authorized and established by Congress in 2006 (Public Law 109-430) with an interagency mandate to coordinate and integrate drought research, building upon existing federal, tribal, state, and local partnerships in support of creating a national drought early warning information system. An effective drought early warning system will communicate drought forecasts, drought conditions, and drought impacts on an ongoing basis to decision-makers at the Federal, regional, State, tribal, and local levels of government, the private sector, and the public in order to engender better informed and more timely decisions thereby leading to reduced impacts and costs.

INTRODUCTION

The relationship between drought and wildfire can appear to be simple, but the drought and wildfire nexus encompasses a profusion of human and environmental impacts. Images of burning forests, neighborhoods, and "smoked out" communities are all now commonplace. Each fire season in the western U.S. Drought inhibits the efficacy of fuel treatments and restoration efforts, increasing wildfire and air quality risks to communities. During recent years, drought in the West has been intensified by warmer temperatures, further accelerating depletion of soil and vegetation moisture. Given terrain slope or strong winds, this dryness exhibits itself through extreme burning conditions that rapidly spread, are difficult to control, burn with a severity damaging to the ecosystem, and are costly to suppress.

The National Integrated Drought Information System, in partnership with NOAA's Western Regional Climate Center (WRCC), the California Nevada Applications Program (CNAP, a NOAA Regional Integrated Science Applications team), the Desert Research Institute (DRI), and the National Drought Mitigation Center (NDMC), hosted the *Integrating Drought Science and Information into Wildfire Management Workshop* in Boise, Idaho on 21-22 October 2015. Seventeen federal, state, NGO, and academic entities attended the workshop (see participant list in sidebar). Because of the complexity of understanding the impacts of drought on wildfire planning, fire behavior, and post-fire restoration efforts, NIDIS views partnering with these organizations and others, such as the Western Governors Association (WGA) and the NDMC as critical to addressing these issues effectively and comprehensively.

The 22 participants in the workshop were invited as representatives of a broad spectrum of expertise including prescribed fire, wildland fire management, climatology, smoke and air quality, fuels management, fire behavior, drought, and policy. This was the first explicit drought-fire focused workshop to occur in the western U.S. and allowed for "big picture" consideration of the role drought plays in fire and its impacts on wildfire planning, fire behavior, and post-fire restoration. In this report, we present the opportunities and challenges the workshop participants identified and the impacts of drought on wildfire. The workshop also provided the opportunity to identify next steps in understanding and addressing drought impacts on wildfire.

Tree rings tell the story of past fires and drought

Tree rings can help reveal the cycle of fire and drought conditions through history. When precipitation is abundant, the rings grow wider. Narrow rings highlight a dry period. Fire scars on a tree matched with the rings indicate when fire occurred. Sometimes these scars are seen at the same time across a large region, such as the Southwest or the Sierra Nevada, providing evidence of a large-scale climate signal (e.g., widespread drought). Tree rings dating back 2000 years have shown extensive drought occurring for decades at a time, phenomena sometimes called "mega-drought" periods. These events are of much interest today because they have been observed in the past, and climate modeling projections suggest they are likely in the future. Water-limited forests may evolve into structures and compositions not common today, requiring a substantial paradigm shift for management.

Hydrologic drought and rangeland drought unfold over different timescales

Hydrologic drought occurs at a minimum of 6 months (one wet season) to many years. Hydrologic drought is driven by a lack of snowpack in the West (or *snow drought*), impacting streamflow, reservoir storage and can expose alpine environments typically shielded by snow to fire. *Rangeland* drought occurs at time scales of several weeks to six months, and the greatest impacts are felt during the growing season. Rangeland drought is driven partially by precipitation deficit, but also high temperatures and increased evaporative demand. For example, during the 2015 summer growing season, the northeastern Great Basin region experienced unusual late spring and early summer rains that drove robust grass growth in the subregion, but concurrently the area continued to be impacted by prolonged, multi-year hydrological drought conditions. These grasses then cured late summer, creating fine fuels for wildfire.[1]

Drought makes vegetation more flammable

Drought reduces tree health and survival. In dense forest stands, these impacts allow bark beetles to thrive. While the *bark beetle* is a natural disturbance agent and outbreaks are not uncommon and can in general improve forest health, in recent years, unprecedented outbreaks have been occurring across western North America.

Precipitation increases *fine fuels* (grasses and shrubs), and a lack of moisture dries them out. These fuels are fire carriers, and historically allowed fire to burn at low intensity across the landscape. Today, places such as the Great Basin and the Southwest have large expanses of grasses that are non-native, and when these burn, they threaten habitat and disturb the landscape in a way that encourages more invasive vegetation species to populate.

'Area burned' is increasing in the West

"Area burned" is a common measure used in wildfire analyses ranging from identifying scientific relationships within the physical fire environment to assessing resource allocations and budgets. A recent increasing trend of area burned in the western U.S. has been noted in a number of analyses; though climate is an important factor, it is not the only driver. Numerous management decisions also reflect area burned through meeting goals and policies of wildland fire management. Annual burned area variations are dominated by drought variability, however, and atmospheric moisture measures (i.e., vapor moisture deficit and potential evapotranspiration) are probably better than temperature as proxies for evaporative effects on fire.

1 This information is from Dr. McEvoy's presentation at the Great Basin Climate Forum, held in Elko, NV on Dec. 2nd, 2015, hosted by the California Nevada Climate Applications Program (a NOAA sponsored Regional Integrated Sciences and Assessments team) and the Great Basin Landscape Conservation Cooperative. Further information can be found at http://www.dri.edu/great-basin-climate-forum-series/gbcf-winter-2015.

DROUGHT IMPACTS: AN UNCERTAIN FUTURE

Many of the impacts identified in the workshop were already present in the absence of drought. However, drought amplifies these impacts and some can transmute into entirely new impacts, both in intensity and consequences. For example, post-fire reseeding success rates in sage-steppe ecosystems are highly dependent on precipitation and moisture; without sufficient rain or snow, native species are less likely to successfully outcompete invasive plant species post-fire, leading to a reduction of native species and habitat. Impacts where drought was implicated as detrimental to fire planning, fire behavior, and post-fire restoration include the following:

- Current planning processes are not flexible enough to manage drought impacts. For example, these processes prevent carrying over restoration funding until ecological conditions are favorable, or the ability to optimize narrow burn windows for fuel treatments.
- Drought conditions can alter where and how fire burns, and amplify safety concerns by increasing hazardous conditions for fire fighters and nearby communities during fire events.
- Drought can increase the likelihood that vegetation types will shift post-fire, allowing opportunities for invasive species to establish.
- Public and agency awareness of drought and wildfires is expanding as large fires become more common, but acceptance of smoke from fuel treatments such as prescribed fire (Rx fire) still lags.
- Extensive drought increases the potential for large wildfires, which produce considerable smoke impacting local and regional public health.
- Drought amplifies firefighting resource demands and increases costs.
- Drought reduces barriers to fire (natural and human-made) by reducing fuel greenness, snow pack and moisture, thus increasing availability to burn.
- Overall, drought increases management uncertainty and worsens treatment effectiveness in fuel management and restoration efforts, decreasing ecological resilience.

IS DROUGHT THE NEW NORMAL?

Drought is a common occurrence in the western U.S., although the frequency and intensity vary through time. The recent four-year drought in parts of the West is not unusual in length, but has been unusual in terms of intensity, associated with temperatures which have been greatly above average. The 2014–15 winter in the California Sierra region was the driest in perhaps the last several centuries. Tree rings from the past 2000 years show that there can be decades of overall drought. It is difficult to predict if the current drought will end soon, or if we are in an extended dry period. Model projections of future climate suggest that drought may become more common given warmer temperatures and increased depletion of soil and vegetation moisture.

CHALLENGES AND OPPORTUNITIES

Workshop participants considered the impacts from and strategies for coping with four scenarios based on the duration of hypothetical drought (four years or ten years) and policy flexibility (high or low). Projected impacts varied in each scenario, but there were several themes that were consistent. For example, the need for *increased public awareness and outreach for drought-related wildfire impacts* was highlighted in all four scenarios, and the need for *improved drought forecasts* was mentioned in three of the four scenarios. Other challenges and opportunities identified in addressing short and long-term drought, with varying levels of policy flexibility, included the following.

Challenges:

- Extended and/or high frequency drought events increase management uncertainty; both primary and secondary impacts of drought on fire behavior and effects are often unknown. This makes long-term planning difficult.
- When resources are allocated from other programs to support fire suppression, fuel management programs may be reduced, creating a chain of impacts that feeds back to affect wildfire behavior, intensity, and frequency.
- The issues of wildfire and drought, similar to other climate related issues, can seem overwhelming to managers.
- There is a need to move away from the fallacy that "throwing money at the problem" will "fix it." The ways in which drought impacts wildfire, at varying timescales, locally and regionally, are highly complex and require coordinated adaptive management actions by multiple agencies.

Opportunities:

- More engagement across agencies and with the public through need and interest. There should be no delaying the conversation about drought impacts on wildfire and forest health.
- Possibility to begin using drought indices as a fire behavior indicator, improving planning and resource allocation
- Increased engagement potential with sophisticated forecast user groups to improve forecast accuracy, utilization, and confidence

UNDERSTANDING AND ADDRESSING IMPACTS OF DROUGHT ON WILDFIRE: NEXT STEPS AND RECOMMENDATIONS

Discussions during the workshop suggest that there are several actions that could be taken to continue moving forward with understanding and addressing the impacts of drought on wildfire planning, fire behavior, and post-fire restoration. These next steps fall into five categories: *knowledge transfer, tool development, science and research needs, communication, and evaluation and metrics.*

Knowledge transfer:

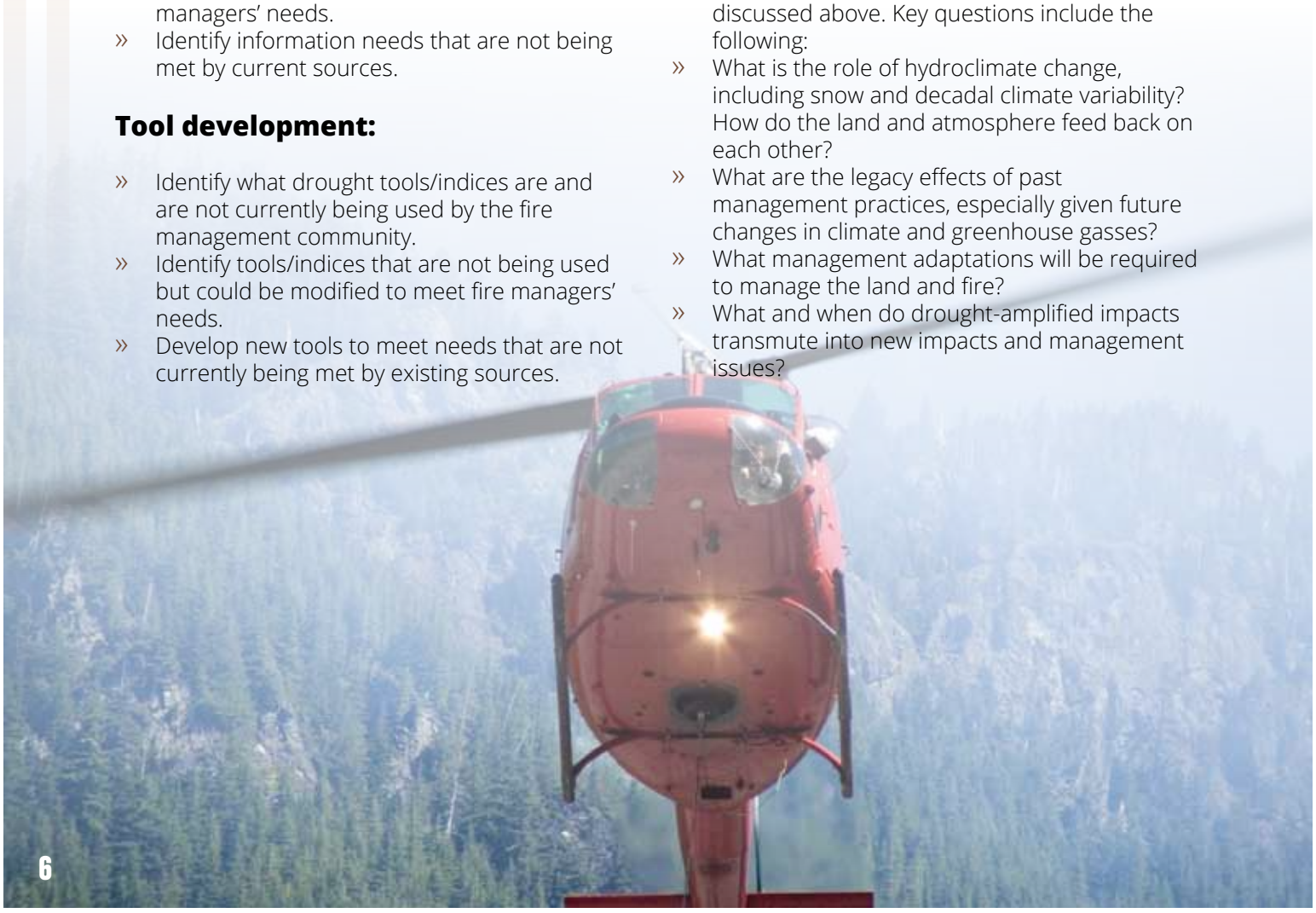
- Increase engagement between the fire and drought communities. This will be key to better establishing how drought conditions could be used as fire behavior indicators, and can guide research and outreach efforts to better integrate drought science into wildfire decision-making.
- Identify drought information that is currently used by the fire management community and determine how it is used in decision-making.
- Identify drought information that is not being used but could be modified to meet fire managers' needs.
- Identify information needs that are not being met by current sources.

Tool development:

- Identify what drought tools/indices are and are not currently being used by the fire management community.
- Identify tools/indices that are not being used but could be modified to meet fire managers' needs.
- Develop new tools to meet needs that are not currently being met by existing sources.

Science/research:

- Develop and/or improve drought-related forecasts targeted at fire planning, behavior, and effects on regional and sub-regional geographies.
- Monitor drought impacts on fire behavior and effects.
- nvest in research to develop and assess the efficacy of fuel treatments (all types) in the context of drought.
- Focus future research on the intersection of climate, fuels, and society to effectively engage in many of the challenges and opportunities discussed above. Key questions include the following:
- What is the role of hydroclimate change, including snow and decadal climate variability? How do the land and atmosphere feed back on each other?
- What are the legacy effects of past management practices, especially given future changes in climate and greenhouse gasses?
- What management adaptations will be required to manage the land and fire?
- What and when do drought-amplified impacts transmute into new impacts and management issues?



Communication:

- Improve public awareness and acceptance of prescriptive fire and other fuel treatments during drought events.
- Increase involvement with air quality agencies to allow for effective use of prescribed-fire burn windows.

Evaluation and metrics:

- Develop an evaluation plan to assess the efficacy of drought/wildfire research in informing the fire management community's decision-making context.

In summary, more and longer droughts often equate to more fire, leading to more global carbon emissions, warmer temperatures, increased soil moisture and vegetation moisture loss, intensifying the drought and fire cycle. As the experts at this workshop indicated, drought worsens management uncertainty and fuel treatment effectiveness in fuel management and restoration efforts, decreasing ecological resilience. Understanding the ecological and climate-related mechanisms that influence the relationship between drought and wildfire as well as impacts on forest health and communities in wildfire-prone areas, is critical to begin mitigating and adapting to these impacts.

Workshop participants categorizing drought impacts on wildfire

The NIDIS team and workshop organizers thank the attendees for their active participation in the workshop and for their input to making this report possible. Agencies represented at the workshop include the following:

- Bureau of Indian Affairs
- Bureau of Land Management/Predictive Services
- Bureau of Reclamation
- California Bureau of Land Management
- Desert Research Institute
- Environmental Protection Agency Region 10
- Idaho Department of Lands
- Lamont-Doherty Earth Observatory
- Montana Department of Natural Resources
- National Drought Mitigation Center
- National Park Service
- NOAA/National Integrated Drought Information System
- NOAA/National Weather Service
- The Nature Conversancy
- University of Oklahoma/Southern Climate Impacts Planning Program
- US Fish and Wildlife Service
- USDA Forest Service
- Western Governors' Association

IMPACTS FROM DROUGHT ON WILDFIRE PLANNING, BEHAVIOR, AND EFFECTS

NO DROUGHT

- Suppression tactics take place normally
- Fuels management teams meet their objectives
- Firefighting expenditures are normal

SHORT-TERM DROUGHT (< 6 MONTHS)

- Fire behavior changes
- Risk of large fires increases
- Ability to manage fires becomes more uncertain under changing conditions
- Prescribed burn windows contract
- Fuel for burning becomes increasingly available
- Restrictions may be imposed on public recreation

LONG-TERM DROUGHT (> 6 MONTHS)

- Fire behavior can become more extreme
- Ability to manage fires becomes more uncertain
- Fire season lengthens
- Cost of suppression increases
- Reduced water availability for suppression
- Wildfire smoke increases, with subsequent health impacts
- Resources for firefighting may become more scarce
- Ecological resilience decreases
- Vegetation mortality increases
- Burn impacts may cause increased runoff
- Ecosystem restoration becomes more uncertain
- Response may tend to "throw money at the problem" rather than taking a more measured approach
- Burnout: Complexity of managing the situation may cause "crisis fatigue", tendency to disengage
- Complex challenges can inspire interagency engagement
- More extreme conditions may require increased policy flexibility
- Intensity of managing the situation may spur better planning
- Communication needs require expanded public awareness of conditions and actions for safety, information and engagement
- Opportunities for engagement with sophisticated climate forecast user groups increase

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