

THE NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM DROUGHT AND WILDLAND FIRE NEXUS (NDAWN) STRATEGIC PLAN: 2018–2022

*Improving the utilization
of drought information in
wildland fire management
for ecological health, public
health, and firefighter safety.*

SEPTEMBER 2018



INTRODUCTION

DROUGHT AND WILDLAND FIRE ACROSS THE UNITED STATES

Drought is a common climate phenomenon that impacts wildland fire¹ planning, fire behavior (during fire events), fire effects (post-fire event), and subsequently wildland fire management overall. While local weather—temperature, wind, and humidity—drives day-to-day fire activity, seasonal climate enables wildfire through wet periods that generate vegetation growth, and dry periods that cure that same vegetation into flammable fuel. The physical relationship between drought and fire is complex given the many and varied first and second order effects at sub-regional and regional scales. The timing, intensity, and frequency of drought events can have wildly divergent impacts on fuel flammability and fire behavior. As one example of a first order effect, abundant precipitation during a particular year can result in increased availability of fuels in forest understories and grasslands, which followed by normal seasonal drying or longer-term drought increases the potential for fire. Conversely, prolonged drought can limit fire occurrence and spread, as the availability of fine fuels (e.g., grasses) are reduced due to lack of precipitation. There are many examples of potential second order drought-fire impacts ranging from unhealthy smoke concentration during a fire to hazardous debris flows in communities and watersheds following a fire. From a human dimension's perspective, wildland fire management agencies are also impacted by drought across a

spectrum of increased uncertainty in decisions and long-term planning, to changes in suppression and prescribed fire resource availability, to the need for more agency coordination. These agencies can benefit from drought information that is focused on wildland fire, improved communication networks, and research targeted at the relationships between weather/climate and vegetation flammability.

Wildland fire is a complex system of interconnected environmental and human components. Fire is frequently in the news, as there is fire (planned or unplanned) somewhere on the U.S. landscape every day. Wildland fire is a significant mission area of many federal government agencies (i.e., U.S. Department of Agriculture (USDA), U.S. Forest Service (USFS), Department of Interior (DOI), National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), Environmental Protection Agency (EPA), Department of Defense (DOD)) as well as a multitude of state agencies and local fire departments, along with international coordinating efforts. Thus, wildland fire receives substantial Congressional and state political attention. Increasing our understanding of the relationship between fire and drought and providing information that improves fire management and safety is a priority for the NOAA National Integrated Drought Information System and its partners.

¹ The term wildland fire as defined by the National Wildfire Coordinating Group (NWCG) includes both wildfire and prescribed fire, where wildfire is an unplanned, unwanted wildland fire, and prescribed fire is any fire intentionally ignited by management actions to meet specific objectives. The NIDIS Drought and Wildland Fire Nexus strategic plan described in this document encompasses the broad spectrum of wildland fire.

THE NIDIS DROUGHT AND WILDLAND FIRE NEXUS

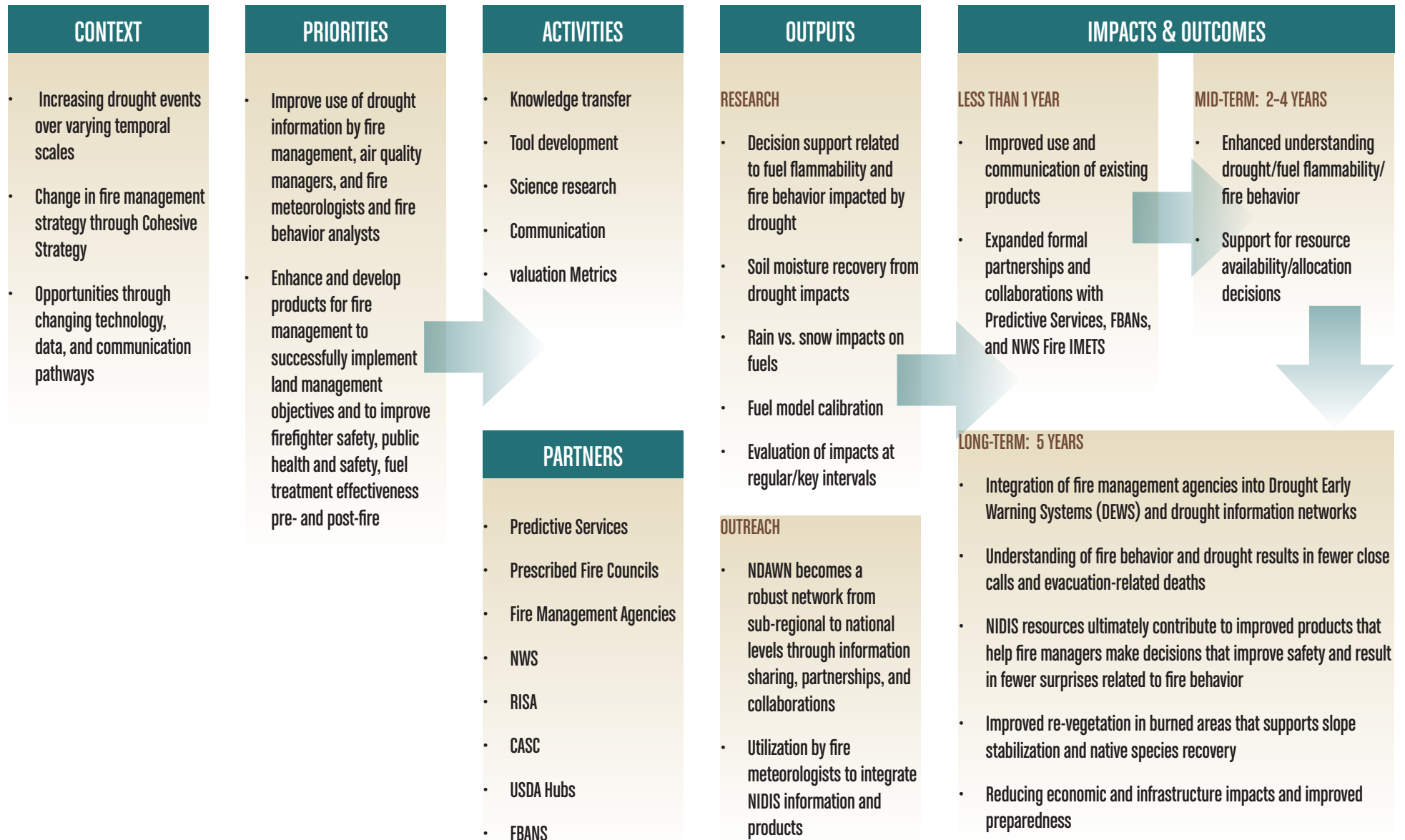
The National Integrated Drought Information System (NIDIS) Drought and Wildland Fire Nexus (NDAWN) defines the needs and challenges of fire managers to effectively utilize drought information and aims to meet those needs and to establish a robust drought and wildland fire decision-support information network. This strategy presents a logical framework to guide how NIDIS investment over the next five years could benefit both wildland firefighters and public health and safety in fire-prone areas of the United States. Broader planning and preparedness topics, including preventing economic and infrastructure losses are addressed as well. As a network, NDAWN functions at multiple scales, from sub-regional to national. This multi-tiered approach of direct engagement with sub-regional stakeholders, regional entities such as the National Interagency Fire Center (NIFC) Predictive Services and the Geographic Area Coordination Centers, and national entities such as the National Wildfire Coordinating Group enables NIDIS and its partners to better understand drought impacts for on-the-ground fire management and identify how drought impacts could be mitigated. The NDAWN Strategic Plan is largely shaped by the outcomes of three primary NIDIS activities—(1) a 2015 western workshop in Boise, Idaho identifying the high-level challenges and opportunities regarding drought impacts on fire planning, behavior, and effects; (2) a 2016 targeted phone survey to better understand how effective and useful current drought information is to fire managers and planners; and (3) four sub-regional workshops in 2017 in the West (Missoula MT, Vancouver WA, Redding CA, and Reno NV) to gather regional specific impacts and needs. The Boise workshop report is available at <https://www.drought.gov/drought/node/1059>. The phone survey and sub-regional workshops are discussed in an internal NIDIS report.

The Boise report identified five themed categories for next steps:

1. Knowledge Transfer;
2. Tool Development;
3. Science Research;
4. Communication; and
5. Evaluation and Metrics.

These categories remain highly relevant and should be used as a guiding principle for future NDAWN efforts. The NDAWN context for NIDIS combined with the above categories allow for the formulation of a logic model highlighting activities, priorities, partners, outputs, and outcomes shown in Figure 1. A set of recommended topical activities based on findings to date (below) and the logic model together identifies exemplar strategic activities for the five-themed categories to benefit the management agencies and public.

FIGURE 1: NIDIS-NDAWN LOGIC MODEL



CONTEXT OF THE LOGIC MODEL

The NIDIS Act of 2006 (P.L. 109-430) calls on NIDIS to “coordinate, and integrate as practicable, Federal research in support of a drought early warning system; and build upon existing forecasting and assessment programs and partnerships.” NDAWN fits well within this NIDIS Congressional authorization. Historical droughts are common across the West, but in recent years have been associated with warmer temperatures and increased evaporative demand and are occurring in a temporally changing climate. Drought and associated wildland fires are also not uncommon in the central/southern plains and the Southeast. Wildland fire management across the country is looking to adapt to a new fire-climate (both physical and societal) regime through a National Cohesive Wildland Fire Management Strategy. There are also increasing opportunities to connect drought and wildland fire through changing technology, data and communication pathways.

PRIORITIES

The Boise and sub-regional workshops have provided the necessary feedback to generate a set of recommended activities over the next few years that will meet the NDAWN priorities of:

- Improving the use of drought information by wildland fire management, air quality managers, fire meteorologists, and fire behavior analysts.
- Enhancing and developing products to improve firefighter safety, public health and safety, fuel treatment effectiveness pre- and post-fire, and meet overall land management objectives.

These priorities are very broad, but by linking the context of the logic model with the recommended primary activities, these priorities comprise the mission of NDAWN.

KEY COLLABORATIONS/PARTNERS

There are established groups working with aspects of drought research and communication, and those who are primarily consumers of drought information. A goal of NDAWN is to better connect these entities to expand and improve formal collaborations and partnerships. Connection with each of these groups to varying extent has already been made but furthering these connections and adding new ones will build the NDAWN capacity. The list of potential new collaborators/partners includes:

- IFC Predictive Services
- Prescribed Fire Councils/Alliances
- Fire Management Agencies
- Cohesive Strategy Regional Committees (Northeast, Southeast, West)
- National Weather Service
- NOAA Regional Integrated Sciences and Assessments Teams
- DOI Climate Adaptation Science Centers
- USDA Climate Hubs
- State Fire Management Agencies
- Private Sector Entities

OUTPUTS

There are two components of the outputs—research/tools and outreach/information dissemination. For research, many science questions were identified over the course of the Boise and sub-regional workshops, along with personnel interactions with the wildland fire and drought communities. In the logic model these are generalized as:

- **Decision support related to fuel flammability and fire behavior impacted by drought;**
- **Understanding decision context and identifying drought tool usage and needs;**
- **Impact of drought on fire effects (post-fire);**
- **Relationship between drought, smoke and human health; and**
- **Utilization/development of evaluation methods and metrics specific to outcomes.**

The outreach/information dissemination component comprises two main themes:

- **NDAWN becomes a robust network from sub-regional to national levels through information sharing, partnerships, and collaborations; and**
- **Increased utilization of drought information by fire meteorologists and fire behavior analysts in prediction and assessment products for decision support.**

OUTCOMES

As NIDIS continues to achieve its goal of increasing capacity to manage drought-related risks, wildland fire is a continuum where drought impacts are substantial from before ignition to post-fire recovery. There are numerous places where research, decision-support, and outreach can be undertaken to improve the use of drought information by fire management and enhance and develop products for decision-support.

A short-term (within the first year) outcome is improved understanding of decision context and the identification of key existing drought products and determination of places and timing, where and when these products might better benefit management activities. For example, there are numerous drought indices used widely within much of the meteorological and hydrologic drought communities but use of these indices within the fire community is considerably limited. It is desirable to understand why there is limited use of the indices, and what indices and drought information would best support fire management. A second short-term outcome is to begin expanding formal partnerships and collaborations with specific users of drought information including NIFC Predictive Services, NWS fire weather meteorologists, and fire behavior analysts.

An important mid-term (2–4 years) outcome is enhancing the understanding of relationships between drought, fuel flammability and fire behavior. This can be achieved through research of short-term weather through seasonal to annual climate variability, relating them to fire behavior and translating those results into management applications. This information can support fire resource availability and allocation decisions.

As drought and wildland fire impacts are expected to increase in magnitude across much of the U.S., there are a number of key outcomes desirable to achieve in the longer term (5+ years). These include: determining how fire management agencies could be integrated into NIDIS Drought Early Warning Systems (DEWS) and drought information networks; understanding of wildland fire behavior and drought in a way that results in fewer close calls and evacuation-related deaths; NIDIS resources contribute to improved products that help fire management make decisions that improve safety and result in fewer surprises related to fire behavior; assessing economic and infrastructure impacts and improved preparedness; and information support for rehabilitation efforts in burned areas that supports slope stabilization and native species recovery.

RECOMMENDED ACTIVITIES UNDER THE NDAWN STRATEGY

The Boise and sub-regional workshops with wildland fire personnel identified many potential activities to better understand and address the impacts of drought on fire behavior, fire effects, and fire management. Drought impacts all of three of these areas and therefore effects management decisions and public safety. The activities outlined below encapsulate a beginning response to address the needs identified by the fire community, and potential actions that NDAWN and partners could undertake—these are guided by and nested into the NDAWN logic framework. These recommendations are not intended to be prescriptive but are designed to serve as a guide to developing NIDIS/NDAWN priorities and specific work statements with partners to achieve drought and fire community results that are actionable. Further, the highlighted topics and actions are not meant to be all encompassing—priorities and activities should be dynamic and flexible in response to changing needs in the wildland fire management community. Prioritizing will depend on budgets, other NIDIS priorities, and leveraging opportunities. In addition to informing decision support for fire management, where relevant, these actions should also be considered for utilization by NWS and NIFC Predictive Services operations, and to inform implementation of the USFS Cohesive Strategy.



STRATEGY

KNOWLEDGE TRANSFER

Key Point: A co-production model should be utilized as much as feasible, though other collaborative models can be highly effective as well such as participatory action research, knowledge exchange and transdisciplinary approaches. The goal is to generate usable science and results; therefore, research should be user and application driven.

Increase engagement between the fire and drought communities.

- Utilize sub-regional workshop connections to build the NDAWN and NIDIS DEWS networks.
- Engage the Joint Fire Science Knowledge Networks in NDAWN activities.
- Prioritize NDAWN engagement with NIDIS DEWS coordinators for regional drought-wildland fire activities and to inform NIDIS DEWS strategic plans.
- Provide training and educational webinars on drought tools and topics relevant for the fire community.
- Develop a process for integrating fire managers and planners and fire weather forecasters and NWS Incidence Meteorologists (IMETS) more fully into NIDIS DEWS planning and information dissemination.
- Work specifically with the three regional Cohesive Strategy teams (Northeast, Southeast, West). Collectively, the regional Cohesive Strategy teams bring together a diverse set of end-users from across the United States. NDAWN products provide support to all three legs of the Cohesive Strategy (safe and effective fire response, fire-adapted communities, resilient landscapes). Initial outreach should focus on working with each regional team and steering committee to 1) introduce NDAWN; 2) identify areas of mutual concern and support; and 3) seek input on prioritizing research needs and information gaps identified in the NDAWN strategic plan.

Improve understanding of decision contexts for fire management and use this to identify information needs gaps and entry points for utilization of existing drought information.

- Train fire managers on the U.S. Drought Monitor so they have a better understanding of what it represents and how it should be used.
 - Determine what drought indices are currently being used in decision-making if these are the most appropriate for fire management.
- Identify drought information and indices that are appropriate for fire management but are not being used or those that could be modified to meet fire managers' needs.
- Determine how new tools (and those tools fire agencies may not be familiar with) such as the Evaporative Demand Drought Index (EDDI), experimental soil moisture forecasts, and sub-seasonal forecasts can be made more relevant for fire managers.
 - Query providers of drought information, specifically NIFC Predictive Services and NWS fire weather meteorologists on information that may be better modified for fire relevance.
 - Explore relevance of EDDI for fire management.
 - Explore potential role of Climate Engine (a climate tool developed at the Desert Research Institute) to provide spatial drought information in wildland fire context.
 - Provide training on drought information and indices to fire personnel.
 - Incorporate drought information relevant to wildland fire in formal national training courses (e.g., S290, S390, Advanced fire behavior, Advanced fire danger).
 - Provide relevant drought-wildland fire information for firefighters in training courses to generate awareness for potential times of extreme fire behavior.

TOOL DEVELOPMENT

Key Point: Consideration should be given to not oversaturate fire management with new tools and platforms. While some new tools may be identified as having decision-support value, emphasis should be placed on existing tools (e.g., indices such as EDDI, platforms such as Climate Engine) that have direct connections to fire and can be utilized directly in decision support.

Adjust tools and indices that were identified as relevant to fire manager needs but with modifications. Increase usage of sub-seasonal forecasts in operational fire behavior assessments.

- Seasonal soil moisture forecasts such as produced by National Centers for Environmental Prediction and University of Washington.

Develop new tools to meet needs that are not currently being met by existing sources.

- Produce analog historical wildland fire season information in relation to drought periods.
- Assess how drought information can inform the National Fire Danger Rating System.

SCIENCE RESEARCH

Key Point: While there is no shortage of research (both physical and social) that could be undertaken on the drought and wildland fire nexus, emphasis should be given to applied and applications research that can be linked to decision making and planning. Research priorities need to be determined in partnership with the wildland fire and drought communities, but also be opportunistic to new questions that emerge and to opportunities to leverage resources.

Develop and/or improve drought-related forecasts targeting fire planning, behavior and effects on regional and sub-regional geographies.

- Develop and improve Seasonal-to-Sub-seasonal (S2S) forecasts of snow hydrology.
- Improve soil moisture forecasting and monitoring in partnership with the National Coordinated Soil Moisture Monitoring Network and other ongoing efforts, such as those within the USDA.

Monitor drought impacts on fire behavior and effects to improve research questions and tool and indices development.

- Determine tipping points in fuel flammability in the context of drought.
- Determine quantitative relationships between drought and fire behavior considering both live and dead fuel moisture.
- Determine extent of drought needed for a given level of fire activity.
- Determine how much dead and stressed fuel is created by drought and how that relates to increases in fuel flammability and large wildland fires.
- Quantify fuel characteristics (e.g., moisture) of the transition period from non-burning to burning.
- Determine drought effects on the fuel flammability season for different ecoregions.

Identify information needs that are not being met by current sources.

- Provide more formal and quantitative links between drought and wildland fire smoke in relation to human health impacts.
- Provide improved quantitative assessments between drought indices and fire danger related indices.

Invest in research to develop and assess the efficacy of all types of fuel treatments in the context of drought.

- Determine impacts of drought in fuel treated areas versus non-treated areas.
- Determine the impact of drought on meeting fuel management targets and objectives.
- Establish role of drought in relation to fire effects of managed fuels (e.g., age of species).
- Quantify impact of drought in relationship to escaped burns.
- Determine impact of drought in relation to fuel breaks and defensible space.

Investigate the role of hydroclimate change, including snow and decadal climate variability.

- Determine the impact of drought on fuels and wildland fire in relation to changing rain to snow ratios.
- Improve understanding of land and atmospheric feedback for incorporation into ecological and biogeophysical models used for fire analyses.
- Quantify drought in ecological models for better estimation of plant response to climate and how that might affect fire behavior and management.

Investigate the legacy effects of past management practices, especially given future predicted climate change.

- Assess scenarios and adaptation strategies given the current state of ecosystem resilience and predicted future changes in climate and wildland fire as it impacts ecosystem resilience.
- Incorporate drought information into National Cohesive Strategy assessments of resilient landscapes and fire adapted communities and improving firefighter safety.

Investigate what management adaptations will be required to manage the land and wildland fire in the future given projected environmental and societal change.

- Assess the vulnerability of species, ecosystems and communities in relationship to changing wildland fire regimes.
- Assess the impacts of climate change and associated policies on tribes, rural communities and other resource dependent communities as it pertains to fire management.
- Assess the vulnerability of threatened and endangered species and develop potential adaptation measures to lessen the impact of wildland fire.

Investigate drought-amplified impacts transmuting into new impacts and management issues.

- Maintain and expand observation networks (in particular fuel moisture and conditions), intensify sampling in some cases; integrate monitoring systems across jurisdictions.
- Monitor the status and trends of key ecosystem characteristics, focusing on threats and stressors that may affect the diversity of plant and animal communities and ecological sustainability in the context of wildland fire.

COMMUNICATION

Key Point: NDAWN in coordination with the NIDIS DEWS and other partners should serve as an established interface between drought and wildland fire stakeholders.

Improve public awareness and acceptance of prescriptive fire and other fuel treatments during drought events.

- Utilize existing NIDIS DEWS, RISA, NWS, and Joint Fire Science Program Knowledge Exchange Networks as communication mechanisms for messaging.
- Develop drought messaging relevant to fire management; this includes identifying the most appropriate index or indices (in particular relevance to fuels and fire behavior), mechanisms for distributing drought information, and reliable sources of information.
- Develop regional and situational drought and wildland fire messaging for the public to help the general audience understand wildland fire in the context of drought, including for prescribed burning.
- Establish and/or improve communication pathways of two-way drought information between drought and wildland fire communities.
- Coordinate and perform, as relevant, activities in NIDIS DEWS strategic plans; NDAWN should also inform updates of those plans.
- Provide drought webinars specific to wildland fire interests similar in style to the current Drought and Climate Outlook webinars provided by the NIDIS DEWS.
- Identify mechanisms to translate relevant drought research to fire management stakeholders for decision-support utilization by tapping into information distribution nodes.
- Identify mechanisms to collect field observations from the fire community for use throughout the drought network.

Increase involvement with air quality agencies to allow for effective use of prescribed-fire burn windows.

- Determine the quantitative role that drought plays in human health from wildland fire smoke and air quality.

EVALUATION AND METRICS

Key Point: Coordinate between on-going and developing NIDIS evaluation efforts and metrics where possible to support overall NIDIS program evaluation. A specific focus of NDAWN evaluation will be tracking information uptake and use, both conceptual and instrumental, particularly data and information that are used in forecasting products.

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

- Coordinate with ongoing NIDIS evaluation efforts.
- Select the most relevant metrics and evaluation methods (i.e., summative vs. developmental).
- Develop a timetable for information gathering and report back to NIDIS and stakeholders (as relevant).

WORKSHOPS

Continue with part-day sub-regional workshops as this method of engagement is economical and yields meaningful input. These sub-regions encompass varying ecosystems, and thus different management responses and needs. These workshops grow the wildland fire and drought practitioner network by taking a more “ground up” approach. Initial key western locations should include southern California, Arizona, Utah, and Colorado. All of these locations are within existing western NIDIS DEWS, and thus can help inform those respective strategic plans. Specific locations will be determined to provide easy access for the fire community. Southcentral (e.g., Oklahoma and Texas) and southeastern (e.g., Florida and Georgia) locations should also be identified for conducting sub-regional workshops in the future.

STRATEGY

SUMMARY

The Boise workshop, survey and sub-regional workshops have provided rich information to aid in understanding the “state-of-drought” in fire management. In addition to these activities, engagement with the fire community in conferences, meetings and other opportunities such as training courses has been undertaken and reinforced the findings from these activities. It is clear that drought has substantial impacts on fire behavior, fire effects and fire management and that these relationships can be highly nuanced and complex. The NDAWN Strategic Plan will guide NIDIS priorities and investments over the next five years to benefit both wildland firefighters and public health and safety in wildland fire-prone areas of the United States.





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