
ASSESSING FIRE MANAGEMENT NEEDS IN THE PACIFIC ISLANDS: A COLLABORATIVE APPROACH

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Wildland fire is a significant and growing threat to communities and natural resources on Hawai'i and the U.S.-affiliated Pacific Islands, including Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, the Republic of Palau, the Federated States of Micronesia, and the Republic of the Marshall Islands (see, for example, Trauernicht and others 2015). Collaborative approaches to fire management are critical because multiple interacting factors—including climate, ecosystem composition, land use history, social-ecological impacts, and cultural perceptions—create highly complex problems (Dellasala and others 2004). However, identifying effective strategies to promote dialogue and knowledge

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exchange among practitioners and researchers and to bridge the “science–management divide” remains a challenge (Roux and others 2006).

Here, we outline our process of facilitating bidirectional knowledge exchange to meet fire management needs for the Pacific Island region through an initial assessment of on-the-ground needs of stakeholders. Our objectives were to provide an opportunity for active engagement among stakeholders, to create a foundation for identifying the availability and relevance of existing information based on management needs, and to inform the development of new fire science.

Facilitating Knowledge Exchange Through Boundary Organizations

Recent work has stressed the importance of “boundary organizations” that can facilitate knowledge exchange by “understanding the decision context and stakeholder perspective, developing strong stakeholder relationships, and

providing information that is accurate [and] credible” (Kocher and others 2012). The Joint Fire Science Program’s (JFSP’s) Fire Science Exchange Network was created as a direct response to the need for improved two-way communication between practitioners and researchers (Wright 2010; LeQuire 2011). The Fire Science Exchange Network consists of 15 consortia working towards improving fire-focused knowledge exchange across all the major ecoregions of the United States (http://www.firescience.gov/JFSP_exchanges.cfm). The guiding principles for the network stress inclusivity, impartiality, facilitation, and (most importantly) the development and delivery of information based on the needs of and continuous feedback from the end users.

Effective knowledge exchange requires identifying not only whom to engage but also how to engage them. Stakeholders are typically identified based on the problem at hand; but differentiating them based on, for example, their relative degrees of interest in a problem and their relative abilities

to influence its outcome can be useful for targeting key sources of information and identifying underrepresented groups (Reed and others 2009). Successful stakeholder engagement, on the other hand, is best approached as a structured, continuous process that identifies explicit, agreed-upon objectives and emphasizes empowerment, equity, trust, and learning (Reed 2008). The success of the JFSP's Fire Science Exchange Network and other "boundary organizations" therefore depends upon their ability to facilitate communication and relationships and thereby provide a service that may be outside the scope of work or skillset of the stakeholders involved.

To meet our objectives, we developed a stakeholder assessment process specifically designed to guide the activities of the Pacific Fire Exchange (PFX; <http://www.pacificfireexchange.org/>). The PFX is a JFSP knowledge exchange consortium established to serve Hawai'i and the U.S.-affiliated Pacific Islands. Although specific to the Pacific Island region, the process we developed might be a useful model for stakeholder engagement elsewhere, and our results offer insight into the needs and challenges inherent in bridging fire science and management.

Wildland Fire on Pacific Islands

The context in which fire occurs on and affects Pacific Island landscapes can be markedly different from continental systems. Prior to human arrival, wildland fire was relatively infrequent and limited locally to volcanic events and rare

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lightning strikes. The region was one of the last places on Earth to be colonized by people (1,000 to 3,000 years ago), and they brought with them the use of fire for agriculture and clearing land. For instance, burning by early Polynesian settlers in New Zealand has been linked to widespread habitat conversion (Perry and others 2012). Similarly, in Micronesia, the establishment and persistence of native savanna vegetation has been attributed to frequent burning by people (Athens and Ward 2004), a practice that continues today.

More recently, the flammability of many Pacific Island landscapes has increased dramatically due to the introduction and rapid spread of nonnative fire-prone grasses and shrubs. These species have altered fuel composition and loads in Fijian and Micronesian savannas, and they form the dominant vegetation cover across nearly one-quarter of the inhabited Hawaiian archipelago (Trauernicht and others 2015). The consequent increase in the availability and continuity of fine fuels, combined with drought, topographically defined dry ecosystems, and abundant human-caused ignitions, has created conditions for frequent, often year-round occurrence of wildland fire throughout the region. For instance, it is estimated that 20 percent of Yap burned under severe drought conditions during the 1998 El Niño (FSM–DRD 2010), while wildland fire records from Hawai'i, Guam, and Palau

indicate that the proportion of total land area burned annually on these islands in some years exceeds that of the Western United States (see, for example, Trauernicht and others 2015).

The impacts of wildland fire are particularly acute on Pacific Islands, given the region's limited land area, the relative sensitivity of its native ecosystems to fire, and the proximity of upland and coastal resources. However, development of fire research and management knowledge on Pacific Islands is limited relative to continental ecosystems. Established tools for fire prediction and operational response, such as standard fuel and fire-spread models and the National Fire Danger Rating System, have uncertain applicability due to extremely steep environmental gradients, sparse weather data, and novel fuel types (Fujioka and others 2000; Weise and others 2010; but see Pierce and others 2014). Given the knowledge gaps, it is imperative that efforts to develop fire science in the Pacific Island region explicitly meet the needs of land managers, fire managers, and fire responders.

The Need for Fire Science Knowledge Exchange

In 2011, the Forest Service's Institute of Pacific Island Forestry, the Hawai'i Wildfire Management Organization, and the College of Tropical Agriculture and Human Resources of the University of

Hawai'i at Mānoa partnered to develop the PFX. The exchange's overarching goal is to improve communication between the science and practitioner communities in Hawai'i and the U.S.-affiliated Pacific Islands by increasing collaboration and by developing and disseminating science-based best practices for fire management based on stakeholder needs.

In 2011, the PFX conducted an initial needs assessment among 46 individual scientists, educators, land managers, and fire responders in Hawai'i and the Pacific Island region as part of a national survey developed by the JFSP (Kocher and others 2012). The top fire-related concerns identified by respondents were watershed protection, land management, and native and invasive/nonnative species, concerns that reflect the drivers and impacts of wildfire. Stakeholders are attuned to such issues, even though a statewide fire assessment did not exist until 2015.

Although the percentage of practitioners who ranked fire as a high-priority issue was large (75 to 86 percent), most respondents consulted fire science information only “sometimes,” “rarely,” or “never.” When split across professions, the percentage who responded in these three ways was 60 percent for fire suppression, 57 percent for habitat restoration, and 75 percent for both mitigation/fuels management and education/outreach. The top two challenges to accessing scientific information on fire management identified by respondents—“the lack of regionally relevant information” and “no centralized source of information”—likely explain

these patterns; they pointed to a pressing need for something like the PFX. In addition, most respondents (72 percent) identified “improved partner communication and collaboration” as the greatest communication need for enhancing fire management in the region.

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Identifying PFX Knowledge Themes

Given the challenge of bridging these information needs, the PFX Steering Committee undertook a collaborative effort to identify and prioritize fire management knowledge gaps for the Pacific Island region. In September 2013, we organized a workshop at the University of Hawai'i at Mānoa to elicit the expert opinion of members of both the PFX Steering Committee and the Advisory Panel. These two governing bodies meet monthly and biannually, respectively, bringing together

a diverse range of perspectives and expertise to ensure that PFX deliverables address stakeholder needs. The experts convened at the workshop included 14 fire managers, fire responders, land managers, cooperative extension specialists, and researchers representing the following agencies and organizations: the Center for Environmental Management of Military Lands; the Hawai'i Division of Forestry and Wildlife; the Hawai'i Wildfire Management Organization; Kamehameha Schools; the Oahu Army Natural Resources Program; the Pacific Disaster Center; University of Hawai'i Cooperative Extension; the University of Hawai'i at Manoa; the U.S. Fish and Wildlife Service; and the USDA Forest Service and Natural Resources Conservation Service. The participants were divided into two groups to brainstorm and discuss any and all wildfire-related knowledge gaps and information needs for the region, categorized broadly into research and management needs. After about 40 minutes, the participants regrouped, outlined the topics brought up, and included any additional ideas raised.

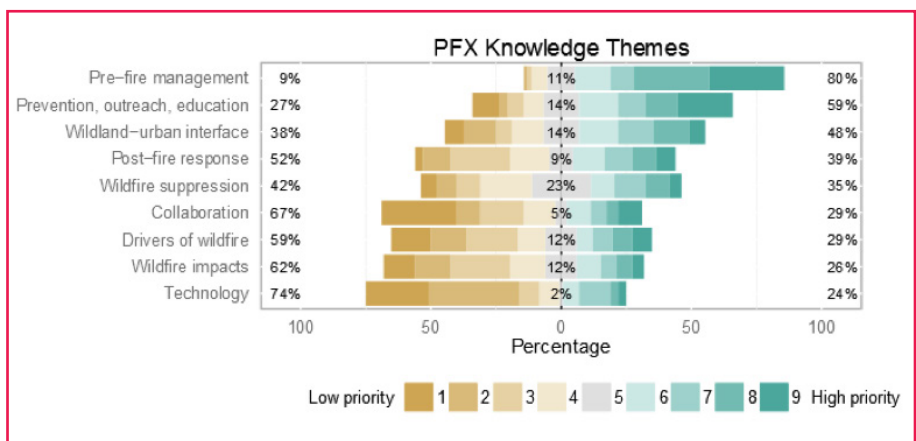


Figure 1—Stakeholder rankings (1 = low priority, 9 = high priority) of the nine Pacific Fire Exchange (PFX) Knowledge Themes that emerged from a PFX Advisory Panel workshop of key stakeholders in fire and land management and research for the Pacific Island region

After the workshop, we organized the resulting topics into a master list of 9 “PFX Knowledge Themes,” each with 5 to 10 subtopics (fig. 1). Given the diversity of needs identified, the PFX Knowledge Themes allowed us to structure stakeholder concerns in a manner reflecting the JFSP’s “lines of work” (http://www.firescience.gov/JFSP_line_of_work.cfm). This approach acknowledges that fire management problems are complex, require the integration of multiple information components, and demand a central role for stakeholders in defining information needs. The PFX Knowledge Themes also allowed us to identify how Pacific Island fire management needs align with the overarching goals of fire-resilient landscapes, fire-adapted communities, and improved fire suppression outlined in the National Cohesive Strategy for Wildland Fire Management (Jewell and Vilsack 2014).

Prioritizing Knowledge Themes

After the PFX Knowledge Themes and corresponding subtopics were outlined, we asked stakeholders to prioritize the development of knowledge exchange products and activities from the list. We sent out a survey (using kwiksurvey.com) in February 2014 and received responses from 66 participants, who gave their relevant work field(s) as land management (70 percent); fire response (17 percent); research (23 percent); agriculture/ranching (12 percent); outreach/education (23 percent); planning (17 percent); and other (11 percent). The respondents also designated their work area as a single

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Hawaiian island (50 percent); all Hawaiian Islands (22 percent); Hawai’i and the U.S.-affiliated Pacific Islands (22 percent); and the U.S.-affiliated Pacific Islands only (6 percent).

Respondents were given a brief explanation of the nine PFX Knowledge Themes and then asked to rank them in order of importance to their work areas. For the Pre-Fire Management Knowledge Theme, for instance, we gave examples of the subtopics within the theme, such as fuels reduction, fuelbreaks, and prefire planning. We then asked participants to separately rank all subtopics identified within each Knowledge Theme in order of importance.

Survey Highlights

Among the main PFX Knowledge Themes, Pre-Fire Management was ranked the highest priority by far among information needs (fig. 1), reflecting the interest

in proactive land management strategies to reduce wildfire risk. The top-ranked subtopics for this particular theme included Firebreaks and Fuelbreaks, Community Wildfire Protection Plans, Greenstrips or Living/ Shaded Fuelbreaks, and Pre-Fire Planning for Land Managers (fig. 2). Prioritizing these subtopics not only helps focus future PFX product development but also allows for the identification of research needs based on the availability of existing information. For example, resources are available for prefire planning and fuelbreak placement and specifications even in tropical nonnative grasslands. By contrast, the design of greenstrips might differ greatly on the Pacific Islands from temperate continental systems, where most existing information comes from. The differences might be in terms of management objectives (such as shading out tropical grasses) and the species that are best suited for this use.

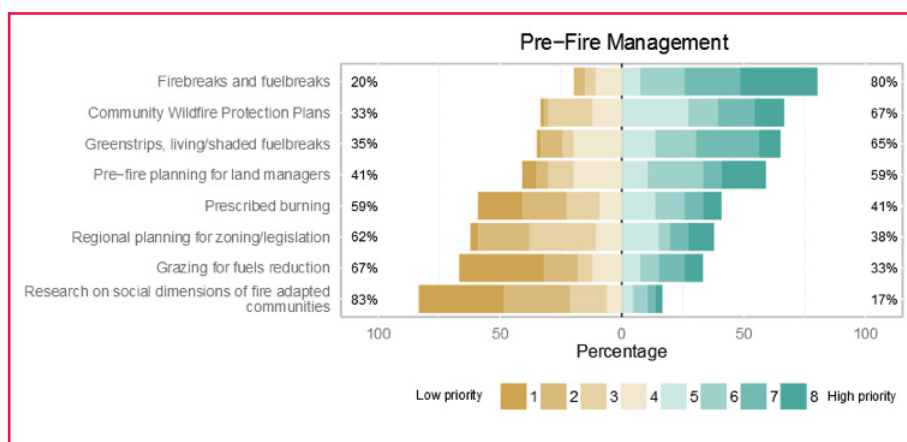


Figure 2—Stakeholder rankings (1 = low priority, 8 = high priority) of the eight subtopics organized within the Pre-Fire Management Knowledge Theme.

The next two highest ranked Knowledge Themes were Prevention/Outreach/Education and the Wildland–Urban Interface (WUI). These priorities highlight the recognition that human dimensions and social issues are critical to improving fire management on Pacific Islands. The vast majority of wildfires in the Pacific Island region are human caused (see, for example, Trauernicht and others 2015), yet no research available for the region examines social questions such as risk perception or the effectiveness of fire prevention messaging.

Wildfire Preparedness Materials and Workshops were ranked highest among the subtopics within the Prevention/Outreach/Education Knowledge Theme. These priorities highlight the importance of efforts to engage communities in fire issues through organizations such as the Hawai'i Wildfire Management Organization. There is also a need to integrate local contexts and cultural perspectives into wildfire outreach information. For example, the Hawai'i Wildfire Management Organization collaborated with the University of Hawai'i Cooperative Extension program to put together images and data from a PFX synthesis of Hawai'i's fire history for the production of a Ready, Set, Go! guide for wildfire preparedness specific to Hawai'i.

The high priority given to prefire management and WUI issues in Hawai'i and the Pacific Island region also attests to the need to develop regionally relevant information. On the U.S. mainland, for instance, wildfire risk increases as development pushes into native fire-prone

habitats; by contrast, wildfire risk in Hawai'i's WUI is primarily linked to the expansion of nonnative fire-prone vegetation and the abandonment of agricultural lands around existing communities. Identifying these issues also indicates how the dissemination of existing resources can be prioritized. For example, statewide community hazard maps are now available through the Hawai'i Wildfire Management Organization (<http://www.hawaiiwildfire.org/wildfire-hazard-assessments>), providing a perfect opportunity to develop strategies for effectively delivering this resource to interested stakeholders.

Wildfire preparedness materials and workshops were ranked highest among the subtopics within the Prevention/Outreach/Education Knowledge Theme.

The need to address local issues is also related to the Wildfire Suppression Knowledge Theme. Hawai'i's novel fuel types and sharp gradients in rainfall and elevation present unique challenges that confound many of the predictive tools applied in the continental United States. In particular, nonnative grasslands in Hawai'i attain incredibly high fine fuel loads (that is, 7 to 15 tons per acre (15,685–27,885 kg/ha)) and cover vast expanses due to widespread abandonment of

agricultural lands (Trauernicht and others 2015). These concerns were also reflected in the top-ranked subtopics within the Drivers of Wildfire Knowledge Theme: Vegetation and Fuels, Effects of Different Land/Resource Uses, Fire Behavior, and Introduced Species.

For the Post-Fire Response Knowledge Theme, Preparedness for Post-Fire Conditions ranked highest among subtopics, reflecting the challenges in Hawai'i and other Pacific Islands of obtaining sufficient quantities of native plant material for site rehabilitation and of using wildfires as restoration opportunities (Loh and others 2009). The low ranking of Wildfire Impacts among the PFX Knowledge Themes may reflect a general understanding that wildfires largely have negative impacts on Pacific Island landscapes and that there is greater need for information on how to proactively mitigate those impacts. Among Wildfire Impact subtopics, Addressing Watershed and Landscape Spatial Scales ranked highest, followed by Native Habitat and Species and by Soils.

Lessons Learned

The PFX Knowledge Themes emerged intuitively from the topics identified by the PFX Advisory Panel. However, asking respondents to sort more than five items can limit any meaningful distinctions among the “middle ground” categories. Therefore, the survey for ranking subtopics within each PFX Knowledge Theme might have been more effective had we asked participants to score the importance of each subtopic individually (such as on a Likert scale of 1 to 5).

Yet a conservative interpretation focused on the top and bottom rankings still affords a clear understanding of stakeholder priorities. In addition, initially dividing the PFX Advisory Panel into separate discussions on research and management might not have served our objectives and was likely unnecessary, given the considerable overlap in participant contributions between these two categories. Finally, we highly recommend the use of “diverging stacked bar charts,” as shown in figures 1 and 2, to effectively visualize, interpret, and communicate the types of data produced by stakeholder assessments (Robbins and others 2011).

The dual-stage approach employed here to identify stakeholder needs was a productive way to engage partners and effectively identify fire management needs in the Pacific Island region. Drawing on decades of collective experience in wildland fire research, management, and response among key stakeholders on the PFX Steering Committee and Advisory Panel helped rapidly identify the major areas of concern. Structuring these needs across the PFX Knowledge Themes streamlined the prioritization process involving a wider group of stakeholders who are concerned about fire but may lack the expertise to identify the full range of fire-related needs.

The initial outcome for the PFX is a “roadmap” for guiding the development and dissemination of best practices for fire management over the coming decade. This information will also allow PFX project leaders and others to assess whether and

how stakeholder needs change as communication and information availability improve. Finally, this process established the importance of stakeholder input for PFX products and activities at the outset and set a precedent for maintaining feedback and building relationships that will increase the impact and application of fire science moving forward.

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